

FERMILAB FRIENDS FOR SCIENCE EDUCATION

ANNUAL REPORT



2006

**FERMILAB FRIENDS FOR
SCIENCE EDUCATION**



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From the Fermilab Director



A handwritten signature in black ink that reads "Piermaria Oddone". The signature is fluid and cursive.

*Piermaria Oddone, Director
Fermilab National Accelerator Laboratory*

A very important recent report of the National Academy of Sciences produced by a distinguished committee of educators, scientists, industrialists and public policy experts under the leadership of Norman Augustine, CEO emeritus of Lockheed Martin Corporation, highlights the importance of science education for the future well-being of the nation. The report, entitled "Rising Above the Gathering Storm," makes recommendations on the actions that we need to take as a nation to maintain our economic competitiveness and well-being in the 21st century.

The three top actions recommended by this committee address the urgent need to improve science and mathematics education. Action A-1, titled "Recruit ten thousand teachers, educate ten million minds," describes a program to attract thousands of new teachers educated in the basic sciences, engineering and mathematics. Action A-2, "Strengthen two hundred and fifty thousand teachers' skills, inspire students everyday," makes specific recommendations on summer institutes, advanced science and mathematics training for teachers, and the development of world class K-12 curriculum materials. Action A-3, "Enlarge the pipeline," recommends creating incentives and opportunities for middle-school and high-school students to pursue science and mathematics.

I am very proud of the role that the Fermilab education program plays in providing students and teachers of the surrounding community access to the resources of our great scientific laboratory. With the help of our Fermilab Friends for Science Education (FFSE), we have created a program that is very much in the spirit of the recommendations above and that is inspirational to both teachers and students. I am very grateful for the support that FFSE provides to our education program.

From the FFSE President

Two-thousand six was another bell-weather year for K-12 education programs at Fermilab.

With additional support from Fermilab Friends for Science Education, scientists and engineers who work at Fermilab are able to have a lasting impact on young students and their teachers.

Helping encourage the next generation of scientists and scientifically literate citizens is an important responsibility of the Fermilab community. Opening the Lab doors to teachers brings them into the world of science where they can better appreciate how 21st century science is done. Taking that experience back to the classroom enhances what the students learn at school.

We know something of the impact from the many thank-you notes and e-mails we receive. The following comments are typical:

“Our visit to Fermilab in March was truly exceptional! Experiencing Dr. Quigg’s enthusiasm coupled with that of young professionals was inspiring to me and my students. I think it is as critical for students to meet and to visit with professional researchers in their disciplines just as young athletes often meet with their professional counterparts.

Several students commented on the enthusiasm and the insight researchers shared. . . . This year, our principal joined his son on our trip to Chicago. He commented that the quality of our visit far exceeded the high expectation I had established. I always learn something new and interesting.”

Timothy Morrison, teacher at Parkway South High School, Manchester, Missouri, on his eighth visit to Fermilab.



Marjorie G. Bardeen

*Marjorie G. Bardeen, President
Fermilab Friends for Science Education*

PROGRAMS

Symposium on the Nature of Science

On May 22, Fermilab presented the 2006 Symposium on the Nature of Science.

The following day Fermilab Director Pier Oddone published his thoughts about the event in his *Director's Corner* column in *Fermilab Today*. Dr. Oddone's remarks capture the essence of the event and underscore the value of Fermilab Friends' contributions:

Yesterday the Laboratory held its yearly Symposium on the Nature of Science, an event that attracted nearly six hundred teachers and students. The Symposium is advertised in Kane and DuPage counties' high schools. While open to all students, it was scheduled right after the conclusion of AP course examinations when AP students can unbury their noses from their books and explore beyond their pages.

The event was sponsored by the Laboratory and the Friends of Science Education. It has an interesting history. It began as an event supported by the Illinois State Board of Education for teachers in the year 2000, the year in which Kansas outlawed the teaching of evolution in their public schools. It seemed then and is still true today that it is important for our society to understand the fundamental nature

of science and the principles that apply throughout whether we do particle physics, mathematics, biology or any other discipline. Today the Symposium gathers together not only teachers but also a far larger number of high school students.

This year's Symposium had a number of outstanding speakers on a broad range of disciplines. Fermilab's Chris Quigg addressed the Nature of Science, followed by University of Chicago Professor Sydney Nagel on the Physics of the Breakfast Table, Northwestern Professor Hilary Goodwin on Lead Poisoning: Advances and Challenges and Professor Stephen Prutt-Jones on Animal Mating Systems: What We See and What We Don't.

The audience was also outstanding. Vibrant and vocal, their enthusiasm was contagious. One of the speakers told me after the meeting that he would love always to have such an interactive audience; this one was more stimulating, inquisitive and exciting than the scientific audiences he normally encountered. Seeing all these students engaged in the lectures and asking important questions gives us great hope for our common future.

Teacher Resource Center

Last year was another busy one for the Teacher Resource Center at the Lederman Science Center.

In 2006, the TRC hosted two special events. From November 15-17, forty educators attended the Project 2061 Atlas for Science Literacy Workshop sponsored by the American Association for the Advancement of Science. The Atlas is a resource that brings together nearly 50 "strand maps" for use in curriculum planning. Strand maps graphically represent paths along which students might progress in their comprehension of science topics, and show conceptual connections among different ideas and skills. The workshop was an opportunity for educators to learn science standards in more depth and understand how the Atlas maps and other Project 2061 resources can assist in coordinating goals, strategies, materials, and assessment for K-12 science education.

As another special offering, the TRC organized and hosted a probeware workshop conducted by Vernier/Texas Instruments, Fourier and Pasco Companies. About forty grade 4-12 teachers from Chicago regional schools attended the session to learn more about electronic probes and software. These devices collect data on phenomena such as temperature, weight, and force and motion, then immediately download the data to a computer. The advantage of probeware for students is that data is represented in real time, allowing students to spend less effort on the mechanics of measurement and more time analyzing data.

In October, thirty-five teachers attended an Inquiry Zone Workshop at the Valleyview School District in Romeoville,

Illinois. The workshop helps teachers develop a personal and collective vision of inquiry teaching and learning. Participants hear about national reports encouraging the use of inquiry teaching and learning and the many facets of inquiry; explore how questions arise; use models to shape questions; and study how to organize and manage classrooms using an inquiry model of instruction.

In ongoing programs, eleven schools or districts participated in Science Curriculum Analysis Workshops during the year. At these workshops, school district curriculum committees spend the day discussing best practices and latest research, learn a process to methodically evaluate materials, and examine the latest kits and texts for teaching science or mathematics, especially in grades K-8.

Throughout the year, numerous teachers took advantage of the TRC's extensive collection of K-12 instructional material, books, periodicals, education supply catalogs, and reports on science and math education, standards, and assessment. Many made use of Internet resources and video tapes and benefitted from personalized consultations with TRC staff. Many undergraduate and graduate education students from eight colleges and universities spent time at the Center during the year as a requirement for their science methods classes. Professors at participating schools have recognized the value of introducing future teachers to the wealth of resources available at the TRC.

The TRC receives support from the U.S. Department of Energy, FFSE and various private and public funds.

PROGRAMS

QuarkNet

In 2000, FFSE applied to the Illinois Board of Education (ISBE) for a Science Literacy Grant to jumpstart high school cosmic ray projects in the state.

The grant money allowed QuarkNet mentors at Fermilab, Argonne National Laboratory and the University of Illinois at Chicago (UIC) to offer equipment and training over and above that provided by QuarkNet.

The following article reports on the work done by Mark Adams at UIC with the aid of the grant money. Future articles will highlight work at the other sites.

Mark Adams is a busy man. A professor at UIC and member of the DZero and CMS collaborations, he also works with ten QuarkNet teachers in the Chicago area. This is no small commitment. As a QuarkNet mentor, he invites high school teachers and students to UIC every summer to learn to build and operate cosmic ray detectors and use data analysis software. Then, throughout the year, he provides ongoing support to the teachers, visiting them and assisting them as necessary.

But Adams feels strongly about this work. Lectures are not enough, he says, and it is important to let Chicago Public School kids learn about science through hands-on experience, using real detectors and real data.

Adams worked with Fermilab engineers on improving data acquisition systems and circuit board designs for the detectors, and he was anxious for each teacher affiliated with his center to have a detector. The ISBE grant purchased the detectors and computers for his teachers. As a result, each teacher who shows a strong level of commitment is able to have a detector and a computer. (Other QuarkNet centers received only one detector, which teachers had to share.) The additional equipment gives teachers year-round access, and gives students additional experience with building equipment and taking data.

Adams values FFSE for the flexibility it gives him in planning his program and for its willingness to seed new ventures.

A couple of years ago, aware that students, as well as teachers, need financial support, Adams approached QuarkNet to offer a stipend to students for attendance at the summer training class in the hope that this would enable more students to participate. The result was that students who attended during the

paid training week became so engrossed that they returned the following week, even though no money was offered.

The summer training sessions are the gateway to the program for students and teachers. Originally, participants were mostly teachers, with only a few bringing along a student. Now Adams tells teachers who want to attend that they must bring at least one student with them. His hope is that teachers will learn what they need in the workshop, but also that they will see that they can step back and let students take primary responsibility for the project.

Training sessions involve minimal lecturing aside from an introduction to astronomy, cosmic rays and cosmology. The main emphasis is on building detectors and learning to operate them. Participants learn to set voltages, take data, and run software to measure the rate of hits.



Summer QuarkNet students at UIC

Students work in groups, with five arrays of four counters in five adjoining rooms. The setup gives overlapping coverage over a wide area and brings home to students how the smaller arrays they have at their schools are only sampling bits of large cosmic ray showers.

Of the ten detectors that Adams oversees, two are at UIC and eight are in the Chicago Public Schools. The equipment is complex, and the process of collection and analysis is not easy, so not every school manages to remain active year-round. Adams says that two-thirds of the participants in his program have put detectors together on their own, and half of them keep them in use. Without a physicist onsite the process can be daunting. So, as part of his commitment to the program, Adams visits the schools when he can.

He says that a visit to Gwendolyn Brooks College Preparatory Academy in Chicago provided one of his “aha” moments. On a visit to check up on detectors, he could see that most of the kids were interested. However, some in the back of the room clearly wanted to show that they were too cool for such things.

Adams asked one student to bend back so that he could place a counter on his chest. Then he placed another counter below, so that a cosmic ray from space would go through both counters. He instructed the kids to say “Zap” when they saw coincident hits in the detectors. Adams says that once the students realized what was going on, every student in the room was eager to get zapped.

CONGRATULATIONS TO HONOREES!

DIRECTOR'S AWARD

More than 200 volunteers contribute time and talents to Fermilab education programs each year. In 2006, FFSE once again sponsored a Director's Award, given to a volunteer whose unpaid contributions to Fermilab K-12 education programs go "beyond the usual level of support."

Curtis Danner was this year's recipient, honored in particular for his ongoing work on the exhibits at the Leon M. Lederman Science Education Center.



Curtis Danner receives the Director's Award from Deputy Director Young-Ke Kim.

In addition to Danner, five other Fermilab employees received citations for their volunteer work. **Muzaffer Atac**, **Don Lincoln** and **Jerry Zimmerman** received finalist certificates; **Ronald Miksa** and **Suzanne Weber** each received a Certificate of Appreciation.

A grant to FFSE from an anonymous donor underwrites the \$1,000 Director's Award. The certificates were presented at FFSE's Volunteers Reception on October 16.

HIGH SCHOOL STUDENT AWARDS

Every year FFSE underwrites an award program for outstanding science students attending high schools in DuPage and Kane counties. Nominated by school faculty, each winner receives a certificate and a book at their school's award ceremony. Winners in 2006 were:

Joe Cacioppo and **Tiffany Benes**, Addison Trail High School; **Brittany Heimann** and **Anthony Karafiat**, Aurora Central Catholic High School; **Clare Goebel** and **Matthew Wash**, Benet Academy; **Megan Marshall** and **Jennifer Getzelman**, Burlington Central High School; **Dustin Hedmark** and **John Yednock**, Community High School District 94; **Sean Britt** and **Jeff Mizek**, Downers South High School; **Oscar Medina** and **Elizabeth Gerhard**, East Aurora High School; **Melanie Rama**, Elgin Academy; **Jeff Johnson** and **Laurel Schwulst**, Geneva High School; **Anup Kumar** and **Adam Greene**, Hinsdale Central High School; **Kelly Costello** and **Donald Abuy**, Immaculate

Conception High School; **Christine Dunlop** and **Matthew Miller**, Lake Park West High School; **John Schoenick** and **Gregory Damhorst**, Larkin High School; **Shauna Gunaratne** and **Timothy Gidron**, Lisle High School; **John Regan** and **Patrick Corcoran**, Montini Catholic High School; **Christopher Chang** and **Nellie Zhao**, Naperville Central High School; **Sarah Carden** and **Vasily Kuznetsov**, Naperville North High School; **Danielle Gewurz** and **Tim Lee**, Neuqua Valley High School; **Kalea Middendorf** and **Nora Mulloy**, Rosary High School; **Joseph Trefilek** and **Daniel Jones**, St. Charles East High School; **Amanda Kunos** and **Emily Zepeda**, St. Charles North High School; **Dan Brandt**, West Aurora High School; **Bradley H. Smith** and **Steven D. Pearson, Jr.**, Wheaton Academy; **Ian Slack** and **Kathryn Livergood**, Wheaton North High School; **Nicholas Ericksen** and **Steve J. Schwab**, Wheaton Warrenville South High School; **David Montgomery** and **Amisha Shah**, York Community High School.

DISTINGUISHED EDUCATOR AWARD

Michael Knapp (Marquardt Middle School, Glendale Heights) and Jeff Rylander (Lake Zurich High School) received FFSE's annual Distinguished Educator Award for teachers who engage students in science, provide leadership for the profession and are associated with Fermilab K-12 education programs.

Knapp's award was for "exceptional contributions to science education, including the well-prepared midlevel students he has brought to Fermilab for the past 12 years; his participation in the TRAC, Beauty and Charm, and Particles and Prairies programs; his work acquainting pre-

service teachers with Fermilab education programs; and his unwavering support as an ambassador for Fermilab and the Fermilab Education Office."

Jeff Rylander's award was "in recognition of his exceptional contributions to science education by engaging students with experiments that measure cosmic rays; originating the first cosmic ray data acquisition board; providing feedback on the Cosmic Ray e-Lab," and for his role as lead teacher at the Argonne QuarkNet Center.

Each received a plaque and \$500 for professional development or for classroom materials.

SCHOLARSHIP WINNERS

In 2006, seven teachers received FFSE-funded scholarships that allowed them to attend workshops or field trips at Fermilab. The recipients were:

Melissa Barron (Jefferson Junior High School): \$225 toward Beauty and Charm; **Lee Hoover** (John Shields Kaneland Elementary School): \$125 toward Friendly Physics: Light and Heat; **Christina Hurley** (Wilmington High School): \$300 toward Summer Secondary Science

Institute in Astrophysics and Relativity; **Joan MacHarg** (Chute Middle School): \$150 toward Particles and Prairies; **Richard MacHarg** (Chute Middle School): \$150 toward Particles and Prairies; **Barbara Romack** (Kaneland John Stewart Elementary School): \$87.50 toward The Prairie - Our Heartland; **Elizabeth Westfall** (Trinity High School): \$300 toward Summer Secondary Science Institute in Electricity and Magnetism.

PROGRAM HIGHLIGHTS

January

FFSE received three grants: one for the Family Open House, another for the Symposium on the Nature of Science, and a third to develop a high school study unit on superconductivity in celebration of BCS@50. Twenty-one participants completed the Fermilab LInC ACT I course, during which they field-tested, technology-supported engaged learning units with students.

February

On February 18 Fermilab hosted its second annual Family Open House, funded by a grant from FFSE. Over 1,500 people enjoyed tours, demonstrations, hands-on exhibits, “make-and-take” sessions, cryogenics presentations and “The Late Show with Leon Lederman.”

March

On March 18 the Education Office presented a workshop on physical science for seventeen grade 5-8 teachers as part of the Chicago Public Schools’ Museum Partners Science Program. Bob Peterson and Marge Bardeen attended the Linear Collider Workshop in Bangalore, where they presented a two-day workshop for twenty teachers on the Cosmic Ray e-lab.

April

On April 30, the Education Office and FFSE hosted the 20th annual Wonders of Science Show in Ramsey Auditorium. About 700 people attended. The show was preceded by a lunch honoring the co-recipients of the Education Office’s 2006 Distinguished Educator Award, Mike Knapp of Marquardt Middle School in Glendale Heights and Jeff Rylander of Lake Zurich High School.

May

Fermilab and FFSE sponsored a Symposium on the Nature of Science for 586 high school teachers and students. Field trips, guided tours, Ask-a-Scientist, Science Adventures, Scout Troops, Hands-on Science and Speakers Bureau, which sends scientists to schools, reached 4,600 participants in this month alone. There were also 201 visitors to the LSC.

June

In 2006, 210 children participated in more than 25 Science Adventures. Classes included Lego Engineering, Leonardo da Vinci’s Art, Unlocking Math and Science Problems, Survival Science, and Camp Invention. Education Office Staff completed *The Prairie-Our Heartland* instructional unit book and a Particles and Prairies DVD.

July

During the summer, 97 teachers attended workshops at Fermilab. These included Summer Secondary Biology and Physics Institutes and The Prairie-Our Heartland, along with the annual Beauty and Charm, Particles and Prairies and Phriendly Physics workshops. Thirteen QuarkNet teachers met at the Lab for an inaugural two-week Teaching and Learning Academy. They developed activities and materials for classroom use.

August

On Aug. 17, FFSE sponsored a Program Leaders’ picnic celebration for Education Office instructors to give well-deserved thanks to all those who offered leadership in a summer packed with a wide range of professional development workshops and programs.

September

Forty-four schools and 4,500 students attended Particles and Prairies and The Prairie-Our Heartland field trips at the Lederman Science Center during the fall season. Fermilab sponsored the Illinois DNR ENTICE Educator Workshop on Illinois Spiders for 30 teachers, and a Phriendly Physics workshop for 41 teachers.

October

On Oct. 16, Fermilab Director Pier Oddone hosted the annual Volunteers Reception giving recognition to those who have helped the Education Office throughout the year. A new tour program for the general public, “Getting to Know Fermilab” (a tour of the Linac, Main Control Room and 15th floor) was inaugurated this month. In the first three weeks there were 20 visitors.

November

Susan Dahl and Spencer Pasero hosted the Chem West teacher network meeting for 30 educators at the LSC. The second session of BCS@50 superconductivity workshop had 10 participants. Ken Cecire, Tom Jordan and Marge Bardeen presented two QuarkNet Cosmic Ray study workshops, one in Japan and the other in Taiwan.

December

Throughout the year, Education Office volunteers including scientists and docents visited classrooms within 90 miles of Fermilab as part of the ongoing classroom visitation program. They led sessions on Force and Motion, Light and Color, the Physics of Sports, Electricity and Magnetism, and several other topics. Nearly 9,000 students attended these presentations.

PERSONNEL

The success of the 2006 FFSE programs rests with these outstanding program leaders.

Michael Albrow, Fermilab • **Michael Bachrodt**, Fremd High School, Palatine • **Richard Billings**, Glenbard West High School, Glen Ellyn • **Sue-Z Bruno**, Gates Elementary School, Aurora • **Joseph Cave**, Naperville School District 203, Naperville • **John Chamberlain**, Glenbard North High School, Carol Stream • **Jennifer Ciaccio**, West Chicago High School, West Chicago • **Trudi Coutts**, Naperville School District 203, Naperville • **Laura Cox**, Glenbard South High School, Glen Ellyn • **James D. Cox**, Clarendon Hills Middle School, Clarendon Hills • **Karl Craddock**, Fremd High School, Palatine • **Larry Cwik**, Naperville School District 203 • **Robin Dombeck**, Maple Middle School, Northbrook • **Jason English**, Fremd High School, Palatine • **Amy Fehrman**, Johnson Elementary School, Warrenville • **Patricia M. Franzen**, Wild Enterprises, Metamora • **Sharon Gatz**, Beebe Elementary School, retired, Naperville • **Barbara Greenberg**, Hinsdale • **Carolyn Gresh**, West Chicago School District 33 • **Randy Jones**, Glen Ellyn School District 41, Glen Ellyn • **Marge Keefe**, St. Charles School District 303, St. Charles • **Steve Keefe**, St. Charles • **Tom Knutson**, Glenbard North High School, retired, Carol Stream • **Leon Lederman**, Fermilab • **Donna Lemmer**, Lombard School District 44, Lombard • **Robert Lewis**, Downer's Grove North High School, Downer's Grove • **Mary Lou Lipscomb**, Illinois Math and Science Academy, Aurora • **Paul Madsen**, Rosary High School, Aurora • **Lee R. Marek**, University of Illinois, Chicago • **Chris Marszalek**, Twin Groves Junior High School, Buffalo Grove • **George McGuire**, Hinsdale South High School, Hinsdale • **Stephen Meehan**, Naperville Community School District 203, Naperville • **Bill Mikuska**, State Microscopical Society of Illinois, Chicago • **Jill Mueller**, West Chicago Middle School, West Chicago • **Paul Nienaber**, Fermilab • **Marcy Novak**, Lombard School District 44, Lombard • **Mary Sue Offut**, SciTech and Field Museum Volunteer, Aurora • **Pat Pentek**, West Chicago Middle School, West Chicago • **Chris Quigg**, Fermilab • **Tom Redig**, Downer's Grove North High School, Downer's Grove • **David Ritchie**, Fermilab • **Barbara A. Romack**, Kaneville North Elementary School, Elburn • **Niki Saolidou**, Fermilab • **Jean Slaughter**, Fermilab • **Patricia Smolucha**, Winfield School District • **Michael Syphers**, Fermilab • **Robert Thompson**, Glen Ellyn School District 41, Glen Ellyn • **Linda Valerio**, Fermilab • **Chris White**, Fermilab • **Herman White**, Fermilab • **Wayne R. Wittenberg**, Glen Ellyn School District 41, Glen Ellyn • **Jerry K. Zimmerman**, Fermilab • **Anna Zuccarini**, Crone Middle School, Naperville

Education Office staff administers and supports the program leaders.

Marjorie G. Bardeen, Manager • Carol Angarola, Administrative Support Assistant • Carol S. Benson, Administrative Support Assistant • Susan M. Dahl, Education Specialist • LaMargo A. Gill, Editor • Thomas A. Jordan, Education Specialist • Nancy Lanning, Public Information Specialist • Waylon Meadors, Computer Specialist • Priscilla B. Meldrim, Public Information Specialist • Laura A. Mengel, Computer Specialist • Spencer L. Pasero, Education Specialist • Robert Peterson, Education Specialist • Elizabeth K. Quigg, Computer Specialist • Gayle Millman, Administrative Support Assistant • Andrea Varry, Administrative Assistant

Docents facilitate student field trips and other Education office activities and supervise the Lederman Science Center.

Lynda A. Ballingall • Karen Bass • Donna Blankenship • Lisanne Canal • Susan Dumford • Mary Hawthorne • Gail Haynes • Maureen Hix • H. Ted Hoesel • David Hoppert • Helen D. Huie • Jacqueline J. Krock • Wendy G. Mouche • Mary Jo Murphy • Gail Poisson • David R. Seymour • Sue Sheehan • Mary Ann Stowell • Felicia Svoboda • Anne Mary Teichert • Yvonne Twomey • William Welch • Larry Welsh • Dorothy Yurs



REVENUES AND EXPENSES

	2005 (audited)	2006 (audited)	24 Years (1982-2006)
Revenue/Contributions (\$000)			
Public Agencies	\$ 34.0	\$ 2.8	\$4,233.2
Private Foundations	23.9	51.1	711.5
Membership	17.0	17.8	315.2
Other	13.0	23.2	388.8
Total Revenue/Contributions	\$ 87.9	\$ 94.9	\$5,648.7
Expenses			
Programs	\$ 119.9	\$ 65.5	\$4,114.3
Administrative Overhead	28.0	31.1	1,398.4
Total Expenses	\$ 147.9	\$ 96.6	\$5,512.7
Excess (Deficit) of Revenue/Contributions over Expenses	\$ (60.0)	\$ (1.7)	\$ 136.0

ACKNOWLEDGEMENTS

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United States Department of Energy
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THE YEAR IN PICTURES



Learning about Earth's rotation on a field trip.



Volunteers demonstrate force and motion during a school visit.



Middle school teachers at the Beauty and Charm training course.



Cub Scouts working on the Engineering badge.



Playing with polymers on a Science Adventure.



At the Family Open House



Middle school students amazed at liquid nitrogen.



Volunteers present Charge! Electricity and Magnetism.