

HOTLINE

The Princeton Plasma Physics Laboratory is a United States Department of Energy Facility

Contact Science Takes Off



The Contact Science team includes, from left, former PPPL'er Dick Rossi, consultant Barbara Graham, PPPL's Nobel Prize Laureate Russell Hulse, and Plainsboro Public Library Director Jinny Baeckler.

By Patti Wieser

Soon, hands-on scientific displays may join book collections and hushed areas of contemplation at the local library.

PPPL's Russell Hulse and Plainsboro Public Library Director Jinny Baeckler are spearheading a project called "Contact Science," which will create, disseminate, and support small-scale traveling science exhibits in public libraries. The first would be installed at the Plainsboro Public Library.

"We would like to provide informal science education to children and their parents by placing science centers in libraries through the use of traveling components," said Hulse, a 1993 Nobel Prize in Physics Laureate.

These components would be tabletop size or smaller and include signage and supporting materials. Each would be integrated into a display suitable for a library and would have stand-alone appeal, as well as serving as a centerpiece to draw people back for other activities.

These associated community-based mentoring activities, building on the main exhibit, are an important part of the complete Contact Science concept.

"I think it is very important for kids to have more hands-on access to science in informal settings. Formal science education in schools is important, but informal science education is also critical," said Hulse. "We want to make learning about science fun and engaging. The purpose of Contact Science is not to teach a science course or serve as a classroom, or be an amusement park. Instead, our goal is to capture the imagination."

He added that libraries by nature provide a more reflective environment than a conventional science center. "Through Contact Science, we hope that children of various ages will have fun, reflect on what they are learning, and build a better understanding of science," he said.

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NSTX Vacuum Vessel Arrives



PPPL's Joe Bartzak assists with the rigging of the National Spherical Torus Experiment (NSTX) vacuum vessel in preparation for lifting the vessel off the delivery truck and into the RESA building. NSTX is now under construction at PPPL and is being built jointly by PPPL, the Oak Ridge National Laboratory, Columbia University, and the University of Washington at Seattle. PPPL has primary responsibility for the Project. See photo essay about the arrival of the vacuum vessel on pages 5 and 6.

PPPL Team Collaborates with Japanese Group



Through a \$660,000 contract with the Japanese corporation AmTechs, PPPL researchers designed and built a correlation reflectometer for JT-60U at JAERI in Japan. The correlation reflectometer measures fluctuations in plasma density and is proving to be important for relating plasma turbulence to transport. PPPL physicist Raffi Nazikian spent three months in Japan this summer helping to install and operate the device. Project subcontractors General Atomics and Millitech provided much of the hardware. The Lab recently negotiated a \$200,000 contract for the control upgrade for the reflectometer. Members of the team, shown with Japanese counterparts, are, from left, Larry Guttadora, Kouji Shinohara, Richard Hawryluk, Takashi Kondoh, Raffi Nazikian, Jun Takahashi, Ken Young, Fumio Nagashima, Mike Choi, and Bob Simmons. Not pictured are Don Long, Phil Heitzenroeder, Art Brooks, Westley Reese, and Bob Cutler.

HOTLINE

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Contact Science

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Hulse said Contact Science teammate Baeckler already runs a wonderful, exciting science center and science activities out of the Plainsboro Public Library. Several years ago, the library's science center received the American Library Association's Fyan Award for the most innovative public library program in the country. An interactive science display would complement the center. "Jinny's enthusiasm and vision of having community-based science in a public library is part of the genesis of this project," said Hulse. Besides Hulse and Baeckler, the Contact Science team includes former PPPL'er Dick Rossi and consultant Barbara Graham.

Said Baeckler, "This could be absolutely revolutionary. We are ever so close to establishing hands-on science as a basic library service. At a time when science is one of the nation's top six education goals, it is important for all public institutions to make significant contributions. By offering high quality science materials, together with pragmatic 'how to' instructions for local librarians and their volunteer demonstrators, Contact Science will enable a whole new avenue for informal science education."

Procter & Gamble, Inc. is funding the Phase I scoping and program development studies for Contact Science. "We are very grateful to Procter & Gamble for their support. Procter & Gamble has a special interest in supporting their home communities, and we will be traveling to Cincinnati, site of Procter & Gamble's headquarters, to discuss the Contact Science program with the Cincinnati library system," Hulse reported.

Hulse and Baeckler began the first phase by visiting several major science centers and museums, seeking a full-service partner to assist with the design and fabrication of the exhibits. They looked for a partner with expertise and experience in making exhibits understandable, accessible, and safe for children, as well as in developing some of the educational materials for the associated community activities.

"Contact Science needed to find an organization to partner with because it doesn't make sense for us to develop a whole design and exhibit fabrication capability on our own," said Hulse, adding that Contact Science recently selected the Science Museum of Minnesota in St. Paul for this task.

Since the museum sells some components of its existing exhibits in optics, sound, weather, and other subjects, this provides a good basis for Contact Science to work with them to combine one or more components and adapt them for the first library displays. In the future, the team may also create exhibits on entirely new themes that could be closely aligned with a sponsoring company's

scientific or technological area of work. "We certainly have a leg up if we start with a museum or science center that has already packaged such exhibit components. They have fun themes and are tested in the sense that you can watch how kids play with them at museums," Hulse said.

Hulse is also on an advisory committee for the Hubble Space Telescope traveling exhibit being created by the Smithsonian Institution in collaboration with the Space Telescope Science Institute. While this type of large exhibit is intended for major science centers, Hulse said his experience of working on the project contributed to the development of ideas leading to Contact Science.

As examples of potential exhibits, one on optics would include light sources, lenses, colored filters, and other materials for hands-on discovery. An electronics workbench would have power supplies and simple electronic devices that could be snapped together to make different circuits, combined with small hand-cranked and wind-powered generators for finding out how much cranking is necessary to power a light bulb.

Because libraries have limited space and the exhibits would be operated by volunteers, each display must have a well-organized, concisely presented theme, although larger themes could be explored through multiple exhibits in a series of stand-alone displays rotated through the participating libraries. Various activities associated with each exhibit would be targeted to different age groups. Contact Science exhibits would be prototyped at the Plainsboro library and travel to other libraries from there.

Once the Contact Science team further defines the details of what an exhibit would constitute, how logistics would be handled, and the cost of selected prototype exhibits, it will move on to the next phase. "The next big step, of course, is to get the money to actually design and build the exhibits. That will be Phase II," said Hulse, adding that the team will seek corporate sponsorship for the second phase. The group hopes to have a good idea of what the exhibits will comprise by the end of this year or early next year.

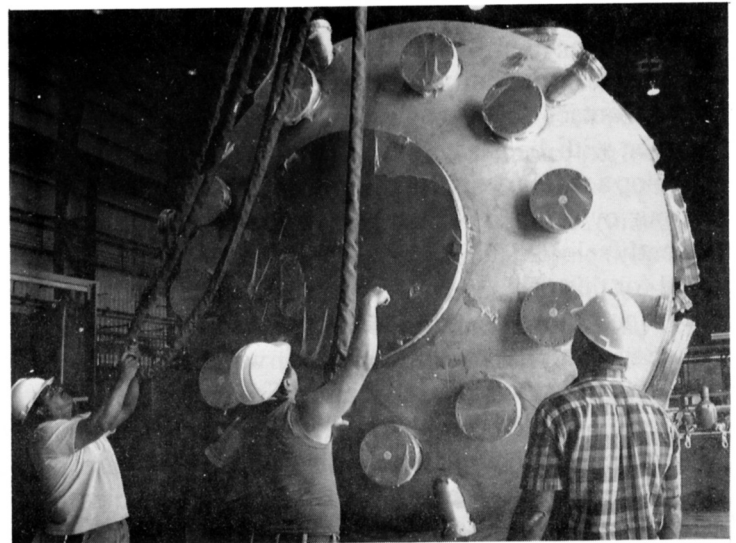
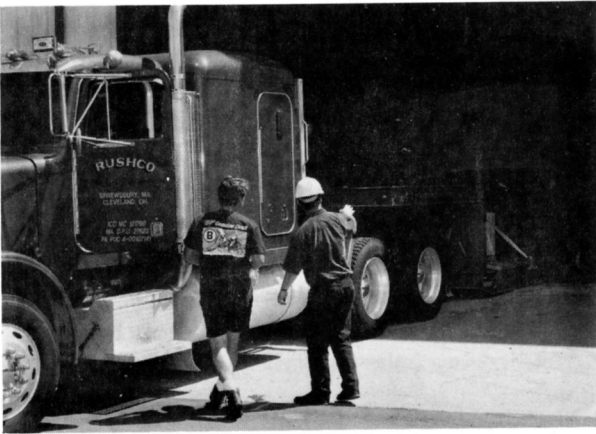
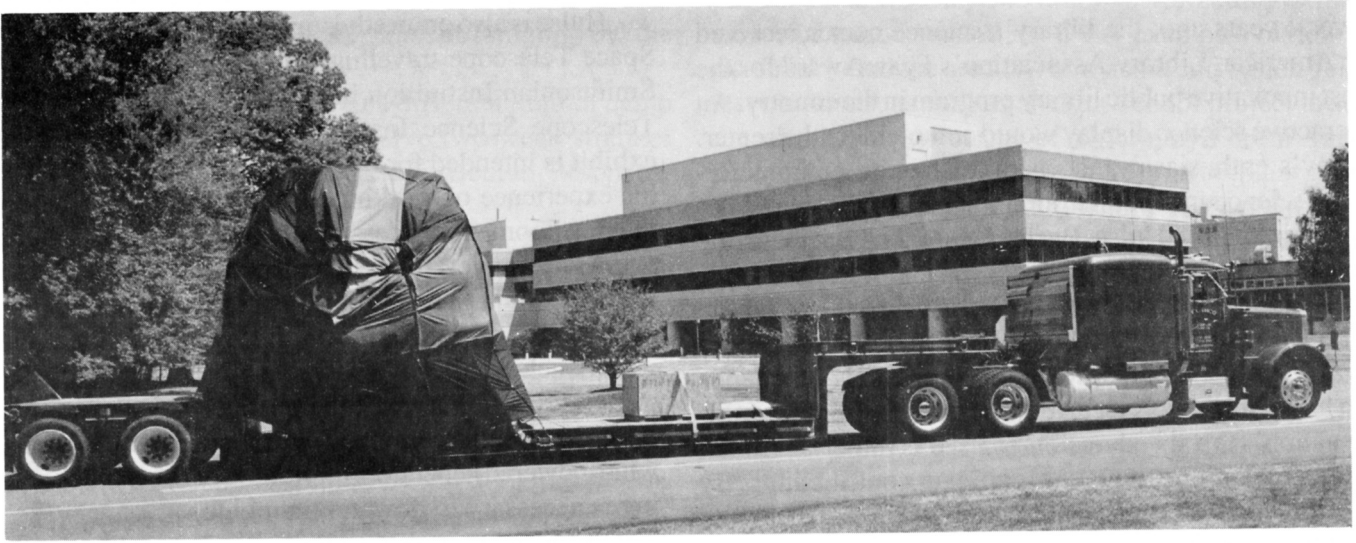
The hoped-for Phase II support will allow Contact Science, a nonprofit corporation, to provide the exhibits to libraries for free, including transportation and maintenance costs. This is a critical aspect of the program, as typical libraries, especially in disadvantaged communities, do not have budgets allowing them to pay for such initiatives.

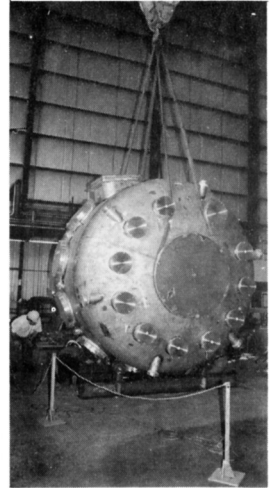
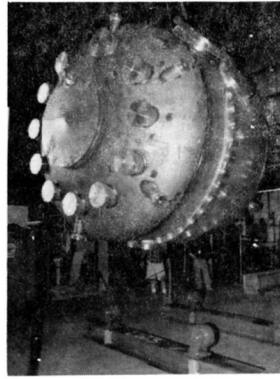
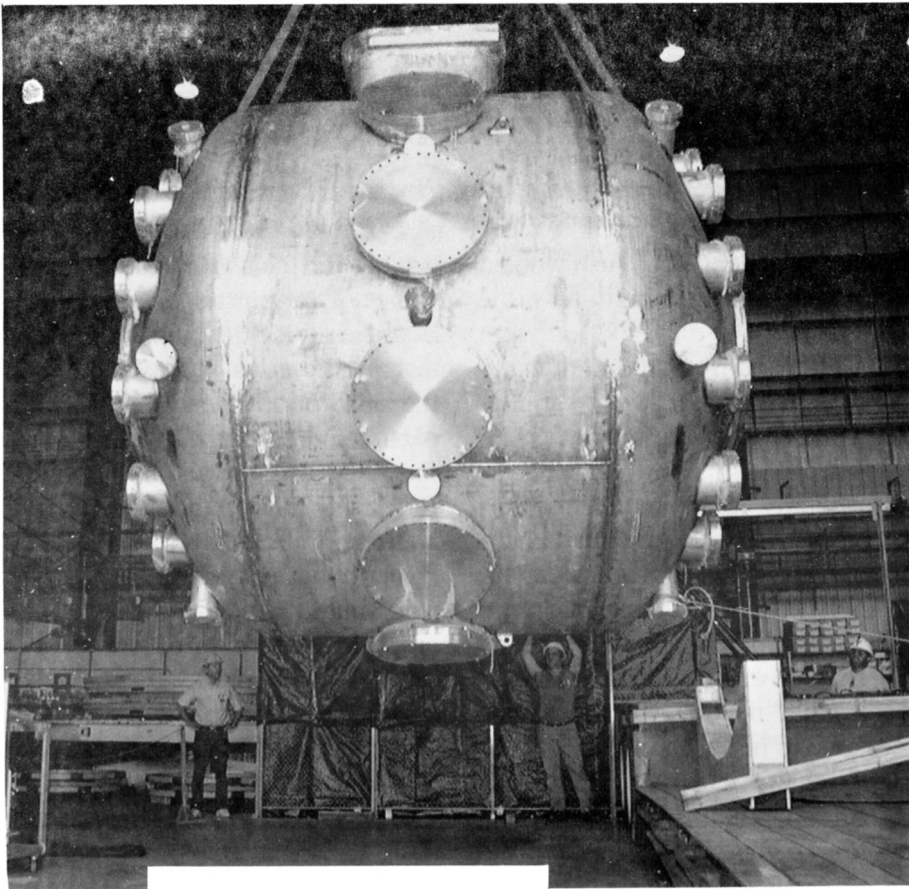
Hulse, who is involved in various science education activities — including Contact Science — for PPPL, stressed the importance of instilling in children a sense of adventure about science.

"Science is not just something you learn in the classroom. It is an exciting, fun part of life," said Hulse. ●

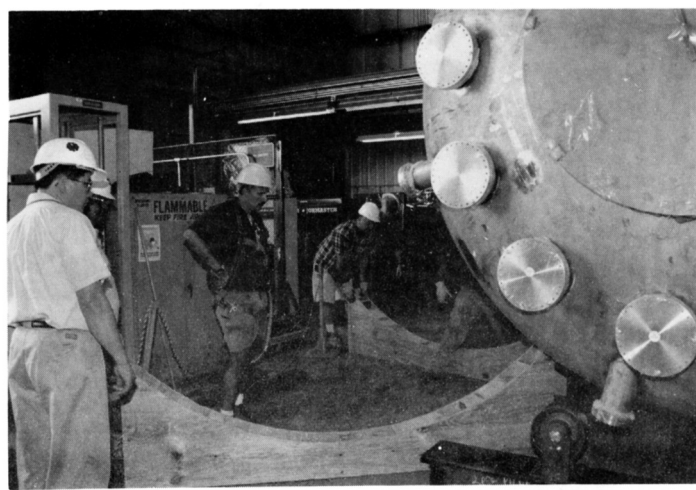
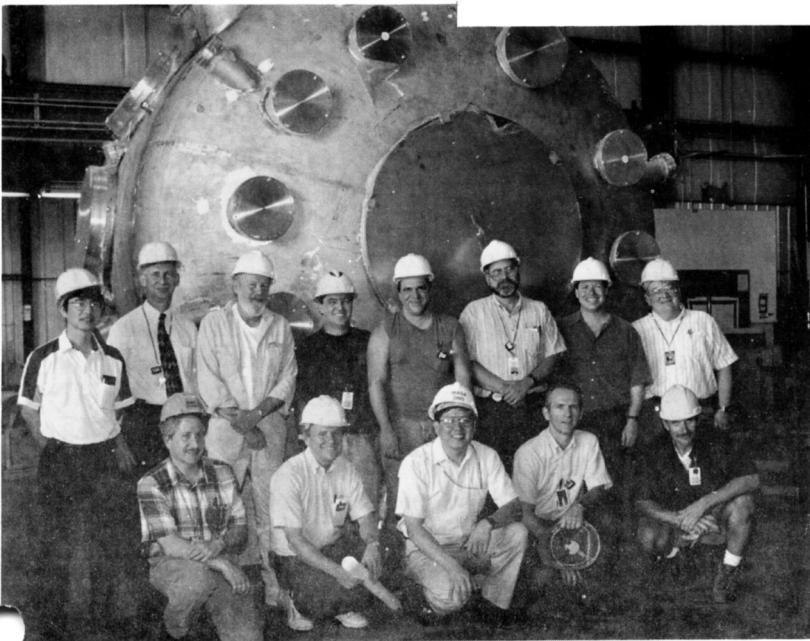
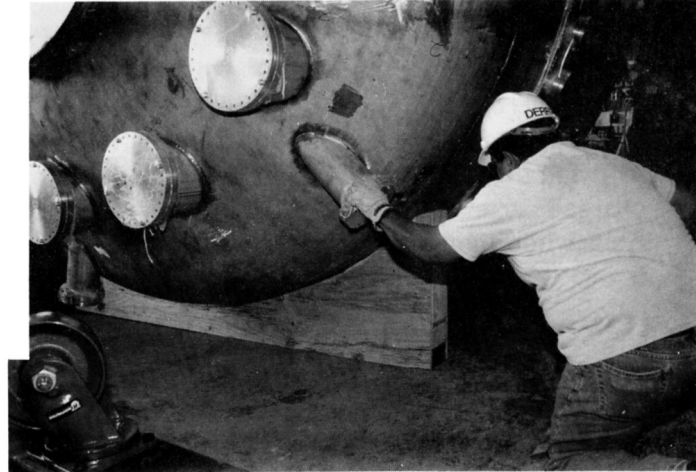
Another Step Along the Way ...

The Vacuum Vessel for the National Spherical Torus Experiment Arrives





On August 5, the 23,000-pound vacuum vessel for NSTX arrived, marking a major step in the construction of the new device. The vacuum vessel is presently being inspected at the RESA building, where mounting surfaces for the poloidal-field (PF) coils are being welded onto it. Once that is done, it will undergo a final machining of the surfaces where the PF coils and the centerstack will be mounted.



PPPL Hosts a Different Kind of Summer Camp

Science Education Institute Helps Teachers Bring Plasma Physics into the High School Classroom

There's no hiking along trails flanked by lush woods, no swimming in a lake, and no singing by the campfire.

This summer, PPPL hosted a different kind of camp — “Plasma Camp” — an intensive two-week summer program of lectures, lab work, and curriculum design for high school physics teachers.

Through the camp, officially called the Plasma Science and Fusion Energy Institute, 10 extraordinary teachers from across the nation traded hikes for lectures about fusion, swimming for experiments with plasmas, and campfire harmony for curriculum planning. The institute's goal is to help teachers develop curricular materials for introductory physics teaching, making the subject of plasma and fusion accessible to high school pupils.

“We hope that by studying the richness and complexity of plasmas through experimentation and exploration of its basic properties, the participants will have the means and the motivation to use plasmas as a new and engaging teaching tool in their existing curricula,” said Andrew Post Zwicker, Senior Program Leader in PPPL's Science Education Program.

At the conclusion of the institute, the participants developed unique, new curricula. One teacher developed software that allows students to follow the motion of a charged particle in both a straight and curved magnetic field, while another came up with a classroom laboratory

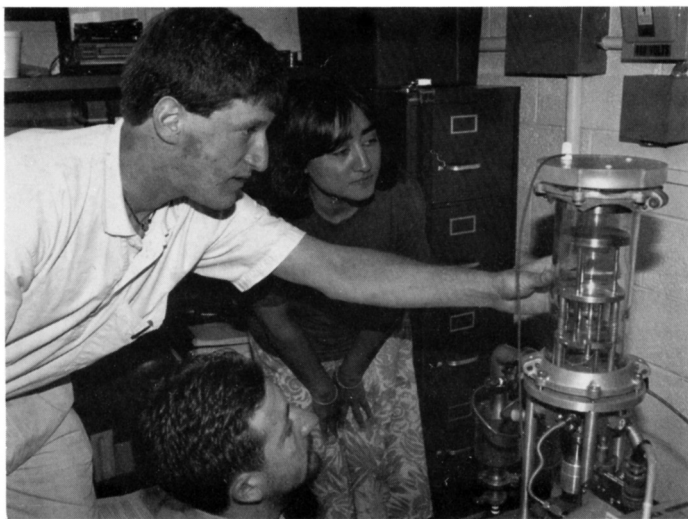
project for measuring the index of refraction to microwaves of various materials. Other examples of new curricula included the creation of plasma and fusion-related test questions, as well as an after-school project to study the absorption spectrum of chlorophyll from various plasma sources and how these sources affect plant growth.

The institute was the brainchild of Post Zwicker, a former post-doctoral researcher from the Oak Ridge National Laboratory who worked on the Princeton Beta Experiment-Modification (PBX-M) from 1992 until it was shutdown. “I remember walking through a dark, empty control room and thinking that if we can't do any physics with PBX-M, maybe we could run it for educational purposes. That wasn't the most practical idea I've ever had, but it was the basis for what we did this summer.”

He added, “Although plasma may be the most prevalent form of matter in the universe, plasma-based curricula may be one of the rarest phenomena in the universe of the introductory physics classroom. Few high school students are exposed to the principles or applications of plasma physics. Demonstrations or laboratories are nearly non-existent and most teachers are not equipped to teach about plasmas beyond the most cursory introduction. This Science Education Program workshop was designed to address some of these issues.”

Participants included a teacher with a Ph.D. in philosophy, two former engineers, a patent holder, a Benedictine monk, and a co-author of a *Physical Review Letters* paper. They were from a mix of private and public schools, varying economic districts, and rural, urban, and suburban areas. In recruiting teachers for the institute, Post Zwicker sought those with experience in an experimental setting and a track record of innovative instruction.

A typical day for the teachers consisted of hearing a lecture on a plasma or fusion related topic; performing experiments in the direct current breakdown of a gas, in plasma spectroscopy, and in microwave interferometry at PPPL's Grad Lab; and discussing how to bring their new knowledge and skills to the classroom. The lecturers included Troy Carter, Phil Efthimion, Bob Kaita, Dick Majeski, Jon Menard, Martha Redi, and Greg Schmidt, all of PPPL, as well as Martin Peng, of the Oak Ridge National Laboratory, Bruce Draine, of Princeton University, and Denise Mauzerall, of the National Center for Atmospheric Research. In addition, PPPL Director Rob Goldston had lunch with the teachers one day, discussing



During “Plasma Camp,” PPPL physicist Andrew Post Zwicker (middle) discusses an experiment with high school physics teachers Brian Wargo (left) and Uma Jayaraman (right). They are using an apparatus at PPPL for studying the conditions under which air can become a plasma. Wargo teaches at Freedom Area High School in Freedom, Pennsylvania, and Jayaraman teaches at Lamberton High School in Philadelphia.



The 10 teachers from across the country who participated in "Plasma Camp" at PPPL are, from left, (back row): Uma Jayaraman, Brian Wargo, Sophia Gershman, Rick Nestoff, Father Michael Liebl, John Wheaton, and Karen Powe; (front row, kneeling): Dennis Robbins, Boris Dirnbach, and Marc Sabb.

topics such as whether someone needs a knowledge of physics to be a productive member of society.

Evaluating the camp, one teacher commented, "I worked harder at this institute than at any other summer project I have been involved with. But I didn't mind. It was worth the effort. I was sorry to see the two weeks end."

Post Zwicker was assisted by Nick Guilbert, who teaches physics at The Peddie School in Hightstown. Guilbert spent close to six weeks at PPPL providing his expertise as a teacher in planning the camp, overseeing the program, and giving advice to the teachers.

"The key to the workshop's success was working with Nick Guilbert early in the design process. His input as an exceptional teacher, communicator, and creator of innovative curricula, as well as the fact that he spent several summers at PPPL as a researcher, were all instrumental in adapting graduate student material to an appropriate level," noted Post Zwicker.

Offered Guilbert, "The teachers took away even more than we had hoped. They learned a lot about plasmas and

seemed excited about taking their new knowledge back to their classrooms."

Plans for next year's workshop are already underway and include inviting all of this year's participants back in addition to bringing in a new set of teachers. The veterans will continue their work in the Grad Lab, as well as design and perform an experiment on the Current Drive Experiment-Upgrade. They will also be responsible for teaching the new group some of what they learned during their first year.

"The idea is to move from scientist-teacher learning to teacher-teacher learning so the ideas taught here can be disseminated to a much wider audience throughout the country," said Post Zwicker. "It is also to demonstrate that a group of high school teachers can use a tokamak to do good science while learning first-hand about some of the intrinsic difficulties faced on a daily basis in fusion research. If we want people to understand what we do and why it is important, what better way than to let teachers perform research here and then take the experience back to their students?" ●

The PPPL Softball Team



This summer, the PPPL softball team participated in the league at Princeton University, vying other campus groups. The final record was 6-9. The Lab's team included graduate students, staff, and summer students from various programs. Team members, from left, are Kyle Morrison, Adam Rosenberg, Greg Lampkin, Sean Strasburg, Team Captain Troy Carter, Sterling Windsor, Riley Crane, Andrew Post Zwicker, Phil Snyder, Alex McDaniel, Mike Obland, Tony Bleach, and Peter Stoltz. Not pictured are Steve Jardin, Russell Kulsrud, Hyeon Park, Masaaki Yamada, Jon Menard, Don Monticello, Jay Johnson, Ed Chao, and Sam Cohen. Congratulations, team!

Five-Year Project for Teachers Concludes



In July, the Science Education staff and Nieves Ortiz-Suarez, a geologist at Princeton University, conducted a two-day workshop for middle-school teachers participating in the National Teachers Enhancement Project, Global Energy and Environmental Solution. This follow-up marks the finish of the five-year National Science Foundation and Department of Energy-funded project. At right, Diane Hague (right) of the Crossroads Middle School and Ortiz-Suarez collect soil samples at Barnaget Bay. In the other photo, a group of the teachers and Chris Ritter of PPPL's Science Education Program (second from right) look at samples collected.