

Magic or Physics?

The third-year student crouched down as a thunderous roar filled the air. Screams of other students rang in her ears and her hands trembled, but she held her ground.

If this sounds like a few lines from J. K. Rowling's latest Harry Potter novel, think again. It actually describes a physics student participating in Physics Day at Six Flags America in Landover, Maryland (Figure 1). Meaghan George, a student at Hammond High School (Columbia, MD), found that participating in Physics Day changed how she views the science. "It's hard to see how some other sciences, such as chemistry, apply to your real life," she says.



"Physics Day showed real-life applications, such as how force and gravity impact you as you go upside down in a roller coaster."

For several years, the American Association of Physics Teachers (AAPT) has worked with Six Flags staff. "Spending Physics Day at the park gives students a new insight into something they may have done all their lives," says Mike Sivell, an AAPT member and physics teacher at Hammond. "They gain an understanding of what it took to develop the rides, and realize that someone had to study physics to do that."

"An understanding of physics is liberating," says Bernard Khoury, AAPT executive

officer. "If you understand physics, the world makes a lot of sense. Physics shows that things do not happen because of magic, but because of systematic, guided principles."

The association's mission is to enhance the appreciation and understanding of physics through teaching, and its members want to help others understand physics and the benefits that a physics background offers.

People often think AAPT is composed exclusively of high-school teachers. In reality, the association's 10,300-plus members range from high-school teachers to university faculty. AAPT is the only professional society of educators to represent members who



teach at such a broad range of educational levels. It is not uncommon at its two annual national meetings to see Nobel laureates talking informally with students or educators (Figure 2). The meeting program and many AAPT information pieces do not show degree designations, because the association actively promotes interactions among people who teach at different educational levels.

"AAPT's greatest strength is our ability to bring together diverse values and viewpoints within the physics community," says Khoury.

In 1930, a group of university professors, unhappy with the lack of attention paid to education by the American Physical Society, formed AAPT. For the first three years of its existence, the association limited membership to those who taught at the college level, and for its first four decades, membership in AAPT required two current members as sponsors and approval by the executive committee. In 1970, the association eliminated the sponsorship and approval requirements and allowed anyone with an interest to join.

Today, AAPT's membership includes four-year and university faculty (30.2%), high-school faculty (30.2%), two-year college faculty (6.7%), students (5.5%), and employees in industry (3%). The remaining 25% of members include retirees, government and nonprofit laboratory workers, and instruc-

Figure 1. Some students who participate in Physics Day at Six Flags America are prevented from flying off the carousel by centripetal force (above), while others listen for the fundamental and harmonic frequencies of the rotating tube (right).



Societies



Figure 2. Anjali Manivannan, a high-school student, is very happy to get an autograph from Nobel laureate Leon Lederman after listening to his presentation at an AAPT national meeting.

tional resource specialists. To serve such a diverse membership, the association has an active publishing program and has developed a broad range of programs for its members. In addition to those for professionals, the association also focuses on programs for nonscientists, particularly students. Its 46 local sections organize meetings and programs for their members.

AAPT publishes two journals—the *American Journal of Physics* and *The Physics Teacher*—as well as the *Announcer*, a quarterly magazine, and several books each year. Currently, about 100 AAPT titles are available. They range from *Biological Effects of Low-Frequency Electromagnetic Fields*, to *Global Warming*, to *The Role of Toys in Teaching Physics*.

“One of the biggest challenges facing AAPT is how to leverage limited resources and limited energy to deal with very important issues,” says Khoury. To do so, the association has developed a set of seven strategic priorities to guide its actions (see box). One of its priorities is Physics for All, based on the principle that all students can learn physics. “The key is to acknowledge that it is our responsibility to teach the subject in a way and at a level that meets the needs and interests of all students, not just the very best,” says Khoury.

Programs such as Physics Day can help broaden the appeal of physics classes. Five years ago, Hammond High School offered three sections of physics for gifted and talented students, and one section for others. In the 2004–2005 academic year, Hammond offered three sections for the gifted and talented, two sections for others, one Advanced Placement section, and one astronomy class. “Physics Day has really helped with enrollment in physics because the kids come back talking about the fun they had,” Sivell says.

Two other student programs are the AAPT Physics Bowl and the U.S. Physics Team. Both programs give students competitive exams, but the similarity ends there. In the AAPT Physics Bowl, 10,000 students compete in one of two divisions, each with 15 regions. Corporate sponsors, such as Texas Instruments and Frey Scientific, donate

prizes for students and teachers participating in the competition.

In the U.S. Physics Team competition, 1,400 students in the United States take the exam. More exams are given until the field is narrowed to the top 24 students. These students attend an intensive 10-day training camp at the University of Maryland. The top five students are then selected to represent the United States at the annual International Physics Olympiad, which began in 1965 as a competition among European nations. The United States has participated since 1986.

AAPT administers the U.S. Physics Team program, which is financially supported by the American Institute of Physics and by donations from association, corporate, and individual sponsors. In 2003, three team members received gold medals and two received silver medals in the international competition, held in Taipei, Taiwan. Although the competition is among individuals, a summary of scores showed that the United States was the top-ranking country out of the 54 nations participating.

In addition to programs for students, AAPT offers programs for educators at all levels. Two such programs target three other AAPT strategic priorities: teacher preparation, assisting crossover teachers (those trained in other disciplines who teach physics), and disseminating research on how to best teach physics.

The New Faculty Workshop draws raves from college and university department chairs. The annual workshop teaches tenure-track appointees how students learn



physics and astronomy, and how an understanding of this learning process can improve a new professor's teaching methods. The National Science Foundation (NSF) funds this and the PTRA program.

The Physics Teaching Resource Agents (PTRA) program is geared to high-school teachers. Leaders at annual five-day institutes help participants develop teaching skills on specific physics topics. They also train participants to conduct workshops for other teachers. An analysis of the results of the Third International Mathematics and Science Study 1999—the second assessment in a series of studies to measure trends in students' mathematics and science achievement—shows that students taught by teachers who have gone through NSF-funded training programs, such as PTRA, demonstrate a greater understanding of science than their peers.

Many of these students go on to pursue physics degrees. Some become educators, and some choose corporate careers. "One of the unfortunate things that happens in the corporate world is that few people have the title of physicist," says Khoury. "This obscures the impact of physics in the real world. If we can find a way to make it more

AAPT's Seven Strategic Priorities

- **Physics for All**—provide all students the opportunity to learn physics.
- **Physics Education Research Dissemination**—perform research on how students best learn physics and disseminate that knowledge.
- **Physics Content at AAPT Meetings**—bring news of current research to educators.
- **Physics Standards**—encourage efforts to define criteria by which physics curricula can be developed and evaluated.
- **Assist Crossover Teachers**—provide support to those whose disciplinary training is not in physics.
- **Relationships with Professional Societies of Other Disciplines**—create interactions and connections with other science disciplines so students can benefit from the integration of the sciences.
- **Teacher Preparation**—work with physics departments and schools of education to improve the science preparation of prospective teachers.

obvious how a physics background can help someone become a successful professional, that would be good."

One way to show others how a physics background is useful in corporate work would be to form connections between corporations and educators. If teachers can see what happens in industry, if they can learn

about the latest uses of technology, they can enhance their effectiveness. "They can get students to recognize that physics has practical aspects in their own community, and they can make their classes relevant to a student's future," Khoury says.

Another way to create a partnership is the Six Flags Physics Day model. Here, the focus is not on connecting teachers with corporate employees who have a physics background but on creating an appreciation of the role physics plays in everyday life and an understanding that there are scientific, not magical, explanations for how things work. "Physics Day is a really effective opportunity to form a connection between a teacher, a school, and a community," Khoury says. "And it might even help create a future physicist."

To learn more about AAPT, contact Warren Hein, AAPT's associate executive officer, at 301-209-3311 or whein@aapt.org.

B I O G R A P H Y

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