Nobel laureate goes back to school

Leon Lederman is passionate about taking physics to the general public and changing the way that science is taught in American schools, as **Peter Gwynne** finds out

What does a physicist do when he has done it all? If you are Leon Lederman – Nobel prize winning particle physicist and former director of the biggest high-energy physics lab in the US – you turn your talents to popularizing science. Since Lederman ended his term as director of the Fermi National Accelerator Laboratory near Chicago in 1989, he has spent much of his time working on ways to inform non-scientists about the joys and significance of science. "I want people to be interested in my results," he explains. "I don't want to storm out of the lab waving data sheets and saying 'look at this,' only to find that there's nobody to listen."

Lederman's interest in spreading the news about science beyond the laboratory takes two main directions. He is developing plans for a television drama that will feature working scientists in much the same way that existing programmes revolve around lawyers and doctors. And he is spearheading a move to change the way in which high schools teach science in the US. Neither pursuit has yet reached a conclusion, but observers credit him with setting the stage for discussions of the issues. "He's caused an awful lot of conversations to take place. That's a crucial element in anything like this," says Larry Kirkpatrick, president of the American Association of Physics Teachers (AAPT) and a physicist at Montana State University.

The 77-year-old Lederman is no newcomer to communicating physics. "Ever since I can remember, I've been interested in popularizing science," he says. "I've been testifying before Congress from early on. That's where you have to make things comprehensible. And I've been teaching freshman physics for years – that's show business." While director of Fermilab he created several initiatives to spread the word about the lab's work throughout neighbouring communities. He started by setting up a series of lectures on Saturday mornings at which scientists discussed and demonstrated their research. Then he created the Friends of Fermilab to encourage young people to pursue careers in science and engineering, and to enhance the quality of science teaching in high schools. Another goal was to promote broader public awareness and understanding of science.

Next Lederman founded the Illinois Mathematics and Science Academy, a boarding school for gifted children where he now serves as a resident scholar. About 60% of the academy's students pursue careers in

Popular appeal – Leon Lederman

science or medicine. Finally, he also founded the Teachers Academy for Mathematics and Science "to ensure excellence in teaching and learning [in] maths and science".

At the same time, he worked hard to improve high-school physics teaching. Lila Adair, who represents high-school teachers on the AAPT board, first met Lederman at a workshop for physics teachers in the mid-1980s. "He expressed a deep concern that students were not being introduced to truly modern physics research," she recalls. "He helped us to produce materials suitable for high school and the university. He took an active role in teaching teachers and sharing data from Fermilab."

Not even the award of the Nobel prize in 1988 – which Lederman shared with Melvin Schwartz and Jack Steinberger for the discovery of the muon neutrino in 1962 – could distract him from popularization. In fact it was his retirement as director of Fermilab in the following year that stimulated his interest in bringing science to the general public. "I had the idea that popular television would be a good vehicle," he explains. "Having the usual physicist's genetic defect of optimism, I thought of a prime-time network television programme that would deal with scientists. It would have the normal television formula, but would teach people about science."

Having obtained seed money from the National Science Foundation and the Department of Energy for the idea, Lederman signed up British documentary film-maker Adrian Malone to create an outline for the

series. He has been trying to persuade television executives to accept the idea for the past four years but it has not been easy. "Newspapers called it LA Science and NYU Blue," he says. "They found it the funniest thing that scientists were getting involved in television."

Fellow scientists have also criticized the concept on the basis that it involves marketing science. Lederman has a ready answer to this attitude. "Marketing is considered undignified," he says. "But who can do it for science apart from scientists?" Meanwhile he continues to offer the concept "to anyone who will listen".

Lederman faces an equally tough task in his efforts to reform science education. His major thrust today is changing the order in which science subjects are taught in high schools. Traditionally, students study biology in their freshman year, followed by chemistry and then physics. In recent years, however, biology has changed from a largely descriptive subject to one that relies increasingly on physics concepts. This has prompted Lederman and others to suggest that students should be taught physics first, followed by chemistry and then biology (see *Physics World* March p10). "It means a change in the way we teach physics," explains Kirkpatrick. "It's more conceptual and involves more problem solving. That should be good for physics as well as the students."

The effort has had some success. "We have a network of about 70 schools that have adopted the 'physics first' approach," says Lederman. "About 35 schools around the nation have already been doing physics first for ten years. They are all almost suspiciously enthusiastic." However, he emphasizes that the approach is in its early days. "We all see the formidable obstacles: not enough physics teachers, and the need for more teaching materials," he says.

Inertia also flourishes. "You've got to be impressed by the system's resistance to change," Lederman continues. "It's so awesome that I have an advisory committee of 28 Nobel laureates and CEOs!" Currently the movement is trying to convince a large state such as California or Texas, which influences curricula around the US, to adopt the physics first approach. "We are at the beginning, but full of hope, like any good physicist," says Lederman.

Lederman's personality provides one source of hope. "His style makes him an excellent teacher," says Adair. "He is very perceptive about the problems of science education in this country."