

AAPT'S PHYSICS TEACHING RESOURCE AGENT PROGRAM

'Teachers teaching teachers' is the hallmark of AAPT's program to use outstanding high-school physics teachers to assist other physics teachers.

Yvette A. Van Hise and Jim Nelson

The problem we have come to call scientific and mathematical illiteracy will produce repercussions for many years unless we address it promptly. Many states have attempted to remedy the situation by increasing their high-school graduation requirements in science and mathematics. Unfortunately, this effort may fail, for two reasons. Not only are there too few qualified science teachers to teach the new classes, but the average age of science teachers in the system is increasing—and no source of new teachers is immediately identifiable.

The problems associated with the shortage of physics teachers in a pre-college setting are even more acute than those associated with teaching other subjects. This is particularly alarming both because physics is a basic science and because physics courses provide students with an opportunity to use the mathematics they are learning. The American Association of Physics Teachers was one of the first groups to recognize the problems associated with science education. In the early 1980s, the association, under the leadership of Jack Wilson, AAPT's executive officer, Donald Kirwan (University of Rhode Island), now editor of *The Physics Teacher*, and John Layman (University of Maryland), then president of AAPT, appointed a "crisis committee" to study these problems and to propose solutions. The committee, led by William H. Kelly, a dean at Iowa State University, identified four basic problems related to the teaching and learning of physics in the nation's pre-college schools:

- ▷ Many high-school teachers feel they have not had sufficient training in physics to teach high-school physics.
- ▷ Physics teachers with a strong background in physics have trouble staying abreast of the rapid growth of

modern physics and of educational research related to the learning of physics.

- ▷ Many middle- and elementary-school teachers would like assistance in integrating more physics into their science lessons.
- ▷ Many administrators do not understand the particular need for teaching science as an activity, as opposed to rote, passive learning.

As one solution to these problems, AAPT initiated a Physics Teaching Resource Agent program with a grant from the National Science Foundation. The association's idea was to select some of the most capable high-school physics teachers in the country and train them as "resource agents." The resource agents would then assist other local physics teachers. Thus the hallmark of the program was to be "teachers teaching teachers." During the 1984-85 academic year AAPT worked to develop the details of the resource agent training program. The association decided that the program would train prospective resource agents in:

- ▷ student laboratory activities
- ▷ using demonstrations to illustrate concepts in physics
- ▷ using computers in the laboratory
- ▷ organizing local physics competitions (that is, regional physics olympic games)
- ▷ the physics of amusement park attractions
- ▷ building student confidence
- ▷ helping the underprepared teacher
- ▷ helping pre-high-school teachers introduce physics concepts
- ▷ topics in modern physics (such as lasers and superconductivity)
- ▷ using media in the classroom (including video disks, videotapes and computers)
- ▷ educational research
- ▷ computer programming in BASIC and PASCAL
- ▷ creating physics examinations and contests
- ▷ teaching astronomy

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▷ building leadership and organization skills.

The organizers of the training institute realized that not even the most outstanding teachers could be expected to become experts in all of these areas in a few weeks; however, they felt that if the teachers were to be effective leaders they should be given the opportunity to grow in as many areas as possible. The organizers also decided that the training courses would be developed and taught by a two-person team consisting of a university teacher and a high-school teacher. The high-school teachers who were members of these teams became the first resource agents.

After the program was announced in February 1985, AAPT received over 900 applications. Members of AAPT then rated each applicant for evidence of a strong physics background, continued interest in self-improvement, professional leadership and creative approaches to teaching physics.

Training begins

Flagstaff, Arizona, is not the first place that comes to mind as a mecca for physics education programs. However, in June 1985 Northern Arizona State University became the birthplace of the Physics Teaching Resource Agent program, with Kenneth Odell and other members of the university's physics department assisting in the birth.

One hundred and four high-school physics teachers convened there to become the first group of resource agents. These teachers—83 men and 21 women—represented almost every state in the union. A few members of the group were in their early thirties or late fifties, but most were between the ages of 36 and 55. Thus they were old enough to have a good deal of teaching experience and yet young enough to commit themselves to the outreach and leadership activities required by the resource agent program. Most of the group had attained advanced degrees, with 76 having at least a master's degree and 10 holding doctorates. The majority taught in public schools, primarily in suburban school districts, but there were 16 teachers from rural districts and 20 from urban schools—so the mix of teachers approximated the breakdown of the types of school districts in the United States. Fifty-two were full-time teachers of physics, while the others taught from one to four subjects or held administrative positions. All of the participants showed an obvious attachment to physics teaching and a pleasure in sharing their enjoyment of physics with their students, and all had applied their creative energies to improving physics education for their students. Almost everyone had created at least one laboratory activity, and many did not even use commercial laboratory manuals at all, relying instead on activities they had developed or adapted. Innovative educational techniques were the rule rather than the exception, and the participants reported that they routinely used field trips, local physics competitions and student projects to spark interest and to keep classes lively.¹

The intensive, three-week training institute that was designed to turn this group of 104 individuals into a highly trained cadre of committed workshop leaders began with a week devoted to computer skills and educational research. Participants were grouped by background and interests for a set of workshops on computer programming. Levels of difficulty ranged from elementary BASIC for the beginners through more advanced work in BASIC and PASCAL. These workshops were all hands-on and self-paced, which helped the participants feel more comfortable using the computer. The computer workshops included large blocks of time devoted to computational physics and computer interfacing techniques, applications and demonstrations. The interfacing workshops were especially valuable because all physics teachers need to be

concerned with the current headlong leap of our society into a highly technological future.

Interpersonal skills were honed during sessions with educational researcher Mary Budd Rowe (University of Florida). These sessions dealt with effective instructional methods, group dynamics in the classroom and the logistics of designing and implementing workshops for other teachers.

The organizers of the training institute provided time during the second week for participants to attend some of the sessions of the annual summer meeting of AAPT, which was being held on the campus. Because the Astronomical Society of the Pacific was meeting the following weekend, participants also spent several days in astronomy workshops, culminating in a trip to the Lowell Observatory and the chance to view Saturn and its moons through the 14-inch refractor.

Participants spent their final week in workshops on building student confidence and on multimedia techniques, taking part in innovative laboratory experiences and discussing Piagetian theories. Sessions on leadership training were added, and were especially helpful for those who had never presented workshops. In addition regional networks were developed to help the agents stay in contact with one another and with AAPT after the training institute was over. For many people, the highlight of the institute was the idea-sharing sessions. Each teacher had been asked to bring along a personally developed demonstration or teaching idea. The enthusiasm for these demonstrations was such that sessions scheduled to last one or two hours stretched into three or four, and the discussions often continued into the night at the dorms or around the computers in the computer laboratory.²

With the training sessions completed, the agents dispersed to begin workshop planning for the ensuing school year; each participant had promised to give two workshops during that year. The goal of the original proposal was to have each member of the network interact with about 20 teachers at each of the two workshops. By the time the first follow-up session was held in conjunction with the AAPT-APS winter meeting in Atlanta in January 1986, that goal had already been exceeded. In fact, by June 1986 the original 104 resource agents had given over 400 workshops involving more than 8000 teachers.³

Enthusiasm for the project remained so high that the 1985 group decided to continue giving workshops when they were joined by a second group of 100 teachers trained as resource agents in the summer of 1986. The second training institute was held at the University of Maryland under the leadership of Kirwan, Wilson, Gordon Aubrecht (Ohio State University), Katherine Mays (Sweeny, Texas) and Nelson. Several of the 1985 resource agents were invited back as instructors. After the second summer institute, Layman replaced Kirwan as principal investigator of the grant. Kirwan then began developing materials and training teacher leaders for elementary teachers. Layman was assisted as principal investigator by Larry Kirkpatrick (University of Montana), Nelson and Aubrecht, who was a visiting fellow at AAPT for 1986-87. During the third summer institute, held in Bozeman, Montana, not only were the materials from the previous two summers improved, but new workshops were added on building demonstration equipment, lasers and holography, modern physics and electronics.

Additional involvements

There are now 300 resource agents throughout the country, including the 50 new agents who joined the program in January 1988. In most cases the activities of



Laboratory activities workshop provided hands-on training for John Roeder of the Calhoun School (New York, New York) and Elizabeth Reagan of James L. Mann School (Greenville, South Carolina).

the participants have not been limited to the promised two workshops. For instance, Paul Hickman, a physics teacher at Cold Spring Harbor High School in New York described his involvement in AAPT as "virtually zero" up to the time he saw the announcement of the 1985 resource agent training institute in the *AAPT Announcer*. "It sounded like a program that really could make a difference, and would give me—as an individual teacher—a chance to make a difference in physics teaching," he states. Hickman elected to remain with the program after 1985, and was invited to be a workshop leader in the 1986 institute. In 1987 he ran workshops on physics competitions for the Long Island Physics Teacher Association and on high-school physics laboratory activities for an April conference in Suffolk. The latter he ran in conjunction with Carole Escobar, a fellow resource agent from Bellport High School in Brookhaven, New York.

This group effort points up another encouraging result of the program: the strengthening of ties among individual physics teachers and physics teacher groups. For example, Hickman also teamed up with Van Hise to present a workshop for elementary-school teachers at the National Science Teachers Association convention in Washington, DC, in March 1987. Both Hickman and Van Hise were thrilled that what was to be a workshop for 25 people turned into a session for almost 100, with teachers sitting in the aisles and standing along the walls of the room. These teachers came from all over the country—from Philadelphia, Pennsylvania, to Tuba City, Arizona. Hickman and Shelley Hamlin, a 1986 resource agent from Sacred Heart High School in Villeplatte, Louisiana, wrote an article on laboratory experiences in the high-school classroom that appeared in the March 1987 issue of *The Physics Teacher*.⁴ In addition Hickman has presented papers at local and national meetings on teaching physics, and he assisted in the laboratory activities workshop at the 1987 AAPT summer meeting.

To keep enthusiasm high and to improve communications among all the resource agents, Hickman, Van Hise and Bob Marzewski of Thomas Valley High School in Loveland, Colorado, have developed an informal newslet-

ter, *The Reporter*. (For more information contact Van Hise at Marlboro High School, Route 79, Marlboro NJ 07746). According to Hickman, "Before my participation in the [resource agent] program, I saw my responsibility as ending in the classroom, or perhaps extending to one other person who asked me personally for help. Now I realize that it goes much further. In order to fulfill my responsibility to the physics teaching community, what I do outside the classroom is often as important as what happens inside."

Being a resource agent does not mean being anointed as one of the "250 best high-school physics teachers." Hickman notes: "It was the training that we got from AAPT that put us in this high-visibility position. Now it is up to us to work as hard as we can to live up to the standards that the program set for us." Many other resource agents note that their professional involvement has also skyrocketed as a result of the AAPT program.

The value of the program is evident to Hickman's superintendent of schools, Fran Roberts, who comments: "To me, one of the greatest values of the program is to put senior master teachers 'hot' from the classroom in situations where their talent can be shared with colleagues. Too much in-service teacher training overlooks these talented people." Other administrators concur. Donald Stanley, assistant superintendent of schools in Milan, Michigan, compliments the work resource agent Merrill Falk (Milan High School) has done to make the elementary-school teachers in the district feel comfortable with physics concepts. Falk notes: "The importance of a teacher being at ease with equipment and concepts cannot be overemphasized. A new confidence emerged on the part of the classroom teacher." Follow-up activities showed that the confidence carried over to the students. "The enthusiasm of the children and the teachers was heartening," says Falk. "Indirect benefits include a new rapport and respect that exists between the Milan High School and Milan Elementary School teachers—each recognizing and acknowledging diverse yet compatible understandings and skills."

Marney Walmsley, principal of Wayzata Senior High School in Minnesota, where John Koser is a resource agent, sees additional developments: "I am hopeful that through that network certain goals will be more attainable because of the national exposure. . . . In all science fields, but particularly in physics, [we need] to discuss how we can attract intelligent young women to the courses and remove those things that might prove to be barriers." Wayzata Superintendent of Schools David Landsverk agrees, adding: "Any efforts which are successful in increasing student interest in this discipline are desirable from both general educational and career-related standpoints. It would be difficult to imagine America's continuance as a major world power without undergoing such underpinning of scholastic commitment. We will continue to encourage John Koser in his [resource agent] efforts and provide support as needed."

Landsverk's last remark is revealing. While the seed money for the formal training and partial support for the workshops and follow-up sessions came from the National Science Foundation, the funds provided by other sources cannot be discounted. For example, most school districts not only have provided resource agents with the time needed to attend follow-up sessions, but have absorbed the cost of hiring substitute teachers for those agents. Districts also have offered free use of school buildings with custodial services supplied, absorbed copying and mailing costs, and loaned equipment. The amount of financial support supplied by individual schools becomes difficult to calculate.

Other organizations have also contributed much to the success of the program. Many AAPT resource agents are also fellows of training institutes that have been run by the Woodrow Wilson National Fellowship Foundation since 1985, or have worked closely in developing and funding programs with those who have attended these summer institutes. A case in point is the newsletter *Spectrum*, developed by David Braunschweig (West High School, Madison, Wisconsin), Paul Quail (Port Washington High School, Port Washington, Wisconsin), and Jay Zimmerman (Brookfield Central High School, Brookfield, Wisconsin). *Spectrum* has been a source of ideas and a communications link among high-school teachers in Wisconsin for the last two years. Much of its financial backing came through Woodrow Wilson resources. AAPT local sections also have sponsored or cosponsored many of the workshops.

Of course, the relationship between agents and AAPT is not one-sided. Mary Ann Kadooka of President William McKinley High School in Honolulu, Hawaii, and Glenn Govertsen of Sentinel High School in Missoula, Montana, both members of the group trained in 1985, were instrumental in starting AAPT sections in their home states. Al Gibson of Adams High School in Rochester, Michigan, helped to revitalize the Detroit Metro Area Physics Teachers, an AAPT affiliate that had become inactive over the previous several years. Less formal groups of teachers began to meet on a monthly basis in many areas for "sharing sessions"—meetings where they could exchange ideas and help ease some of the feeling of isolation arising from being the only physics teacher in a school. Many members of the network took on new responsibilities as officers in their local sections or by serving on local or national AAPT committees. Nelson now serves as the high-school representative on the executive board of AAPT.

An unanticipated benefit of the program has come about because the resource agents did not limit themselves to dealing with fellow high-school teachers. Projects and workshops reached down to the middle schools and elementary schools; one resource agent even ran a workshop for teachers of kindergarten through grade three. At one of her elementary-school workshops Sandy Rhoades of the Westminster Schools in Atlanta, Georgia, offered to go to the participants' schools and either give demonstrations for their students or simply act as an adviser if the individual teacher had questions and problems. Rhoades reports that her idea "was so successful it almost backfired on me. The response has been more than I can handle. I feel that I could devote almost a full schedule to going around to the grade schools and giving 'physics' advice. If anyone doubts the worth and validity of the [resource agent] program, this is just a single testament to the fact that the need and desire for these sorts of activities are tremendous!"

And, as was their original goal, the resource agents have given workshops. Over 1000 workshops had been reported by January 1988. AAPT has estimated that there are currently about 22 000 people teaching physics at the pre-college level in the United States. A total of 25 000 individuals have participated in these workshops, but a portion of that figure represents repeat participants. (In fact, some teachers have become "workshop groupies," coming to every workshop that they possibly can.)

Future of the program

Even if the statistics indicated that every physics teacher in America had been to at least one workshop, it wouldn't mean that the program has outlived its usefulness. More work is entailed in upgrading physics instruction, starting

from the elementary-school level, than the 250 current resource agents could ever hope to accomplish. So now that the formal training sessions are completed, how will the program be sustained? How will new people be brought in to replace those who retire or move into administrative positions? The 1987 grant proposal for the program addresses that issue. It is well to recall that the original group of resource agents was selected from an applicant pool of over 900 teachers. Many of these teachers were highly qualified but could not be chosen due to geographical considerations, to give one reason. Others were selected for the training institute but were denied leaves of absence by their boards of education, and so could not attend. Still others may have had personal or professional commitments that prevented them from even applying. Along with many participants from the Honors Workshop at the Virginia Military Institute and Woodrow Wilson institutes, these are the teachers we hope to add to the resource agents already working. Also, teachers from the physics community at large who have been active in leading programs for other teachers will be provided with the opportunity to participate in the follow-up sessions. With this additional training, they will be able to achieve resource agent status. The ultimate goal is the formation of a self-sustaining group of 300 well-prepared physics teaching resource agents.⁵

The resource agent program will be undergoing an evaluation. According to Layman the effort will be multipronged. There will be three groups involved: AAPT itself, an outside research and evaluation group that will be hired to look at the program, and a few outstanding physics educators who will be selected by the leaders of the resource agent program. We hope that the successes of the program now only seen anecdotally will be verified statistically. If they are, the program will serve as a model for other programs being developed by NSF.

Aubrecht feels that the program is the best possible response to the crisis in physics education on the high-school level. "The strengths of the program are in the mutual support system it has built, the sharing of ideas which work among their colleagues, more active involvement of the [resource agents] as individuals in the affairs of AAPT, the opportunity for [pre-college] physics teachers to hear talks on topics at the forefront of interest for physicists, the opportunity for high-school teachers to attend national AAPT meetings and become more knowledgeable in physics, and the professional encouragement and opportunity for professional growth afforded through the program." Although the resource agents' penchant for performing their duties rather than completing their paperwork was occasionally exasperating, Aubrecht's experience with them was very positive. "This is really important work, and very rewarding," he says. Or as Rob Reiland, a resource agent from Shady Side Academy in Pittsburgh, Pennsylvania, summarized his feelings and those of his colleagues, "I think this is the best thing to happen to physics education since the GI Bill."

References

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5. J. Layman, J. Wilson, principal investigators, 1987 Physics Teaching Resource Agent Grant Proposal: Honors Workshop for Physics Teaching Resource Agents. ■