Annual Evaluation Report for
Rural Physics Teacher Resource Agents

Covering Period from June 2004 to May 2005

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Introduction

This report summarizes the activities and findings of Horizon Research, Inc. (HRI) in its external evaluation of AAPT's Physics Teacher Resource Agents (PTRA) Rural project since June 2004. During this period, from June 2004 to May 2005, HRI has:

- Administered pre- and post-institute questionnaires to the PTRAs attending the 2004 PTRA institute;
- Observed a portion of the PTRA institute in Sacramento;
- Conducted two focus group sessions with a total of 12 PTRAs who led the 2004 rural institutes;
- Interviewed a random sample of 10 PTRAs who attended the 2004 PTRA institute;
- Administered a questionnaire to all teachers who attended the 2004 rural institutes;
- Assisted the project in the development of and administered (in a pre-test/post-test design) a kinematics, dynamics, energy, and momentum content assessment to outreach participants attending rural institutes focused on these topics;
- Observed a sample of the 2004 rural institutes; and
- Assisted the project in the development of and administered a student assessment focusing on kinematics, dynamics, energy, and momentum in a study of the impact of the AAPT/PTRA rural program on students.

This report is divided into five main sections. The first provides an overview of the AAPT/PTRA Rural project and a description of the key questions guiding the evaluation. The second presents data on the 2004 PTRA institute, including PTRAs' expectations for the institute, their perceptions of the quality of the professional development, and the impact of the institute on their preparedness to lead rural institutes. The third section reports data collected on the rural institutes held during the summer of 2004. These data include a description of the 25 rural institutes and the teachers attending them, as well as feedback from the PTRAs leading these institutes. This section also reports the results of a study of the impact of the project on the content knowledge of outreach participants. The fourth section describes a study of the impact of the AAPT/PTRA Rural project on student achievement in kinematics, dynamics, energy, and momentum, which is currently in progress. The final section summarizes the key findings and presents HRI's recommendations for the project.

Overview of the AAPT/PTRA Rural Project and Evaluation

As stated in the grant proposal, the primary aim of the AAPT/PTRA Rural project is to "serve isolated and neglected rural teachers by building on the experience, expertise, and resources of the existing PTRA program. The project will provide opportunities for these teachers to grow professionally in physics content, in the use of technology for instruction, and in established teaching strategies. Additionally these teachers will develop into a professional and supportive network." To accomplish these goals, the project has adopted a trainer-of-trainers approach. The first tier consists of the PTRAs, typically accomplished physics teachers. At a week-long PTRA institute, the PTRAs are trained to present workshops on a wide variety of physics topics.

Most institute workshops are six-hours in length and focus on familiarizing the PTRAs with the classroom activities in the workshop manual. The institute also provides opportunities for the PTRAs to network and share ideas related to the classroom and to workshop leadership. The major goal for the summer institute is to provide the PTRAs with the knowledge and skills needed to effectively lead institutes for rural teachers.

PTRA-led rural institutes, the second tier, are typically five days long and are intended to focus on one or two core physics topics (e.g., kinematics and dynamics). In addition, the project has included two, day-long follow-up workshops in the model. These workshops are intended to give the outreach participants an opportunity to revisit concepts and skills from the rural institute and to share and reflect on their efforts at incorporating what they learned into their classrooms.

The rural institutes include a strong technology component, seeking to introduce outreach participants to a number of the tools that can be used to support physics instruction, including graphing calculators and calculator/computer-based laboratory activities. These institutes also give rural teachers, who are often the only science teacher in their school, an opportunity to network with other science teachers. At this second tier, the project expects to have an impact on rural teachers' understanding of important physics content and their use of effective teaching strategies. Further, the project hypothesizes that these changes will lead to impacts in student learning.

The evaluation plan for the AAPT/PTRA Rural project contains both formative and summative components and focuses on seven key questions:

1. How successful is the project at recruiting and maintaining a cadre of PTRAs, including teachers from the areas being served by the rural centers?

2. To what extent does the PTRA institute prepare PTRAs with the physics and pedagogical content knowledge needed to present outreach workshops?

3. To what extent does the PTRA institute prepare PTRAs with the leadership skills and professional development strategies that will enable them to design and implement extended high-quality professional development workshops that provide in-depth examination of physics content and standards-based teaching strategies?

4. How successful is the project at initiating and maintaining the network of rural centers, including recruiting, training, and providing on-going support to each Rural Regional Coordinator?

5. How successful is the project in reaching the goal of providing 108 hours of professional development (over three years) to under-served rural teachers and what is the quality of that professional development?

6. What impacts does the project have on outreach participants' attitudes, physics and pedagogical preparedness, and classroom practices?

7. What impact does teachers' participation in the rural institutes have on their students' achievement in physics?

Although it is too early in the project to answer these questions fully, data collected during the project's third year provide some insight into the project's progress in reaching its goals.

Preparation of the PTRAs: The 2004 PTRA Institute

As noted above, the goal of the PTRA summer institute is to equip the PTRAs with the knowledge and skills necessary to provide high-quality, effective professional development for rural teachers. The skills and knowledge needed by the PTRAs include:

- In-depth understanding of physics content;
- Knowledge of, and experience using, effective physics teaching strategies;
- Knowledge of effective professional development strategies/adult learning theory; and
- Skill at designing and implementing high-quality professional development.

The PTRA institute incorporates a variety of activities, including presentations by physics professionals, a session in which PTRAs share a favorite classroom activity or demonstration, and opportunities for networking. However, the main component of the institute is a set of workshops which focus on various physics topics, technological tools (e.g., graphing calculators), and/or teaching strategies. These workshops are developed by selected PTRAs, members of the project leadership, and/or other interested and knowledgeable members of the physics education community. Most of these workshops are six-hours long, though a few are three-hours in length. The workshops provide opportunities for the PTRAs to experience a sample of the classroom activities included in the workshop manual, and a forum to discuss physics content, classroom practices, and issues of leadership.

In July of 2004, the project gathered 85 PTRAs in Sacramento, CA for the institute. This year, three new PTRAs attended the institute. The project offered 13 workshops during the 2004 PTRA institute, covering topics such as kinematics, electricity, energy, laboratory interfacing devices, and graphical analysis. This section of the report focuses on the quality and impact of the PTRA institute using data collected from the pre- and post-institute questionnaires, evaluator observations, and interviews with PTRAs.

The PTRAs

The pre-institute questionnaire gathered a variety of data from the PTRAs, including demographic characteristics and information on their learning needs as professional development providers. Seventy PTRAs responded to the pre-institute questionnaire, a response rate of 82 percent. Table 1 shows the demographic characteristics of the responding PTRAs. Sixty percent of the 2004 PTRAs were male; nearly all were white. About half taught in suburban schools, the rest were evenly split between rural and urban schools. Eighty-one percent taught physics and/or physical science during the 2003–04 academic year and two-thirds have over 20 years of teaching experience. The majority of attendees became PTRAs prior to 1997; 16 percent have become PTRAs since the beginning of the rural project in 2002.

Table 1
Demographic Data for PTRAs Attending the 2004 Summer Institute

	Percent of Respondents (N = 70)
Physics/Physical Science in Previous Year Teaching Assignment	81
Gender	
Male	60
Female	40
Race/Ethnicity	
White	96
Asian or Pacific Islander	1
American Indian or Alaskan Native	1
African-American	0
Hispanic	0
Other	1
Location of School	
Suburban	52
Urban	24
Rural	24
Year Originally Became a PTRA	
1985–1988	27
1992–1996	36
1997–2001	21
2002–2004	16
Membership in Professional Organizations	
AAPT	96
NSTA	57
Years of Physics/Physical Science Teaching Experience	
0–5 Years	1
6–10 Years	9
11–15 Years	9
16–20 Years	14
21–25 Years	14
26–30 Years	24
31–35 Years	14
36 or More Years	14

The Quality and Impacts of the PTRA Institute

PTRAs' Needs and Expectations

Knowing what participants' needs and expectations are for a professional development experience can provide valuable insight into their perceptions of the quality of that experience. The pre-institute questionnaire asked PTRAs the extent to which additional training in a number of areas would help them become more effective professional development providers. As can be seen in Table 2, the PTRAs' perceived a moderate to strong need for additional leadership training in many areas. About three-quarters of the PTRAs cited working with adults (i.e., research on how people learn, and principles of effective professional development facilitation) as an area in which they needed further training. Roughly 60 percent indicated needs in areas related to their own classroom practice (i.e. physics content and activities). Close to half of the

PTRAs saw little or no need for additional training in physics content. It is not surprising that learning physics content was not a major area of need, as many of the PTRAs are well-versed in physics.

Table 2
PTRAs' Needs for Additional Leadership Training

	Percent of Respondents (N = 70)		
	No to a little additional training	**Moderate amount of additional training**	**A good deal to a lot of additional training**
Strategies for implementing the principles of effective professional development in workshops for other teachers	21	46	33
The research on common misconceptions/student thinking in physics	21	54	25
The research on the principles of effective professional development	24	47	29
The research on how people learn	26	40	34
Activities for physics instruction	34	47	19
Technologies for physics instruction	39	39	22
Physics content	46	40	14

The data on what the PTRAs hoped to gain from the institute contrasts with their professed needs. The most common response, given by 30 of the 69 PTRAs answering this open-ended question, was increasing their repertoire of classroom activities. Learning teaching strategies to use in their own classrooms and increasing their knowledge of physics content were also mentioned by many PTRAs (22 and 19, respectively). Only 17 PTRAs indicated that they hoped to learn new strategies for working with adult learners. These data indicate that many PTRAs entered the institute focusing on what would benefit them as a teacher rather than as a workshop leader. As three PTRAs wrote:

> *[I hope to learn] new ideas and techniques for teaching physics and physical science.*
>
> *I expect to increase my content, what I teach and delivery, how I teach.*
>
> *[I hope to get] continued reinforcement in both content and teaching strategies.*

Data from the post-institute questionnaire[1] show a similar pattern. When asked why they had selected to participate in the workshops they did, the most common response, given by 19 of the 56 respondents, was that they selected workshops to increase their ability to teach the topic to their students. As three PTRAs wrote:

> *They had ideas I could use in my classroom.*
>
> *I want to teach [topic] this way to my students next year.*

[1] Fifty-six PTRAs returned the post-institute questionnaire, a response rate of 66 percent.

[I was] looking for new ideas to teach students.

Eighteen PTRAs said they chose their workshops because they are included in the rural institute sequence, and 15 stated that they selected workshops they had never taken before. One PTRA wrote:

They contain important content, content of interest to all physical science/physics teachers in middle as well as high schools. I hoped to get new ideas/activities for my own teaching as well.

These data from the pre- and post-institute questionnaires indicate that there was a mismatch between the PTRAs' needs (i.e., training as professional development providers) and what they were hoping to get out of the PTRA institute (i.e., classroom activities and teaching strategies).

PTRAs' Experience at the PTRA Institute

The main vehicle for preparing the PTRAs as professional development providers is the institute workshops. The project offered 12 workshops during the 2004 PTRA institute, plus a three-hour leadership session. Table 3 shows the title, duration, and percentage of PTRAs taking each workshop. The workshop taken by the greatest number of PTRAs was *CASTLE (Capacitor-Aided System for Teaching and Learning Electricity)*, which was offered as a sequence of two, six-hour workshops. Having a large number of PTRAs trained in the *CASLTE* workshop should benefit the project as electricity is the core topic covered in the third year of the rural institutes' three-year sequence.

Table 3
Participation Data for Workshops
Offered during the 2004 PTRA Institute

	Duration (Hours)	**Percent of PTRAs Taking Workshop in 2004 (N = 56)**
CASTLE (Electricity)	12	58
Make and Take	3	49
Leadership and Workshop Methods	3	48
Gravity	6	45
Interfacing – Vernier	3	44
Energy – Societal Issues	6	43
The Electromagnetic Spectrum (NASA workshop)	6	42
Interfacing – PASCO	3	41
Momentum and Impulse	6	39
Energy	6	26
Kinematics	6	26
Graphical Analysis	6	20
Newton's 2nd Law	6	20

Data collected from the PTRAs after the institute indicate that they considered the workshops to be of high quality. As can be seen in Table 4, a majority of PTRAs rated the quality of instruction in each workshop as high in quality; all responding PTRAs rated *Graphical Analysis, Interfacing-Vernier,* and *Newton's 2nd Law* highly.

Table 4
PTRAs Rating Workshop Instruction as High Quality†

	N‡	Percent of PTRAs
Graphical Analysis	11	100
Interfacing – Vernier	22	100
Newton's 2nd Law	11	100
Make and Take	25	96
The Electromagnetic Spectrum	21	95
Interfacing – PASCO	21	95
CASTLE (Electricity)	31	94
Kinematics	13	92
Momentum and Impulse	20	90
Energy-societal issues	23	87
Gravity	25	84
Energy	14	79
Leadership and Workshop Methods	25	64

† Includes those who rated the item a 4 or 5 on a five-point scale from 1 "poor" to 5 "excellent."
‡ By design, not all PTRAs participated in each workshop; the total number responding for each workshop is included in the table.

The PTRAs were also asked on the post-institute questionnaire and in interviews[2] what aspects of the institute were particularly good. The quality of specific institute workshops was mentioned by 15 of the 49 respondents on the questionnaire and by 6 of the 10 interviewed PTRAs. As these two PTRAs said during interviews:

> *I liked two things, being with the other PTRAs and the CASTLE workshop. I spent two days at the CASTLE workshop. At first I was not clear about where it was going and at the end of the first day I was on board, and now I want to try the materials here at [my school], and it will help me to lead workshops of that nature at other institutes.*
>
> *A couple of the break out sessions were good…Kinematics and Gravity were very good.*

Networking/sharing ideas with other PTRAs was also cited as being particularly good aspects of the institute. These aspects were mentioned by the majority (30 of 49) of the questionnaire respondents and by half of those interviewed.

[2] During the winter of 2004–05, HRI conducted telephone interviews with a random sample of 10 PTRAs who had attended the 2004 PTRA Institute.

Although only 64 percent of the participating PTRAs rated the *Leadership* workshop as high quality, the project may interpret this finding positively. This year, the leadership made a more concerted attempt to focus the PTRAs more on issues of leadership than on their own classroom instruction. A key component of this effort was a major revision to the *Leadership* workshop. In previous years, the session was devoted mostly to reviewing the various forms and record-keeping requirements for the outreach institutes. This year, the *Leadership* workshop included a much greater focus on issues related to professional development.

The interviews with PTRAs asked about their opinions of the *Leadership* workshop. Seven out of 10 interviewed PTRAs had attended the workshop. Of these, four PTRAs indicated that they found the workshop to be helpful, with two PTRAs saying the workshop encouraged them to increase their emphasis on pedagogy in their outreach workshops. One PTRA stated that the session was informational about the vision of the program. The three who did not find the workshop helpful indicated that they thought too much time was still devoted to reviewing forms and procedures and wanted more time spent on improving their practices as professional development providers.

Given the changes in the *Leadership* workshop, it is not surprising that the session was met with mixed reactions from the PTRAs. These changes may have forced some PTRAs out of their comfort zone by challenging them to reflect on their practices as professional developers rather than classroom teachers. However, these changes are likely to have a positive impact on the project in the long run, and provide a start that can be built upon in future institutes.

In addition to asking the PTRAs about their perceptions of the quality of the summer institute workshops, the PTRAs were asked about the extent to which the institute focused on various goals. The data indicate that the institute focused heavily on what the PTRAs hoped to get (i.e., classroom strategies and activities) and less on what they indicated they needed to be more effective professional development providers. As can be seen in Table 5, 85 percent of the PTRAs indicated that the institute provided ample opportunities for getting new activities for physics instruction. Only 54 percent indicated that the institute focused heavily on effective professional development strategies. The research on common physics misconceptions, principles of effective professional development, and research on how people learn were mentioned by a minority of PTRAs (40, 33, and 26 percent, respectively). These areas that were less of a focus of the institute are the same areas in which a substantial proportion (approximately three-quarters) of the PTRAs prior to the summer institute indicated they needed a moderate to a great amount of additional training (see Table 2).

Table 5
PTRAs' Indicating that each of the Following Occurred† at the Summer Institute

	Percent of Respondents (N = 56)
Gained activities for physics instruction	85
Gained experience with technologies for physics instruction	68
Learned strategies for implementing the principles of effective professional development into workshops for other teachers	54
Learned physics content	53
Learned about the research on common misconceptions in physics	40
Learned about the research on the principles of effective professional development	33
Learned about the research on how people learn	26

† Includes those who rated the item 4 or 5 on a five-point scale from 1 "not at all" to 5 "to a great extent."

These data are consistent with HRI's observations at the summer institute. In the sessions HRI observed, the majority of the time was spent having the PTRAs work through classroom activities as if they were students. There were times during the workshops when the leaders discussed strategies for working with teachers in outreach workshops. However, the amount of attention to this topic varied widely among the workshops. In addition, these "discussions" often consisted of the leader sharing tips on how they facilitated an activity with little opportunity for the PTRAs to reflect on, or receive feedback about, their leadership skills. The PTRAs rated the quality of the workshops highly, as would be expected given that the PTRAs entered the institute primarily interested in improving their classroom practice.

Impacts of the PTRA Institute

By comparing responses from the pre- and post-institute questionnaires, HRI is able to examine the impact of the institute on the PTRAs' perceptions of their preparedness to provide the 12 workshops offered in the PTRA institute to outreach participants.[3] For 5 of the 12 workshops at the institute, PTRAs participating in a workshop had significantly greater increases in their perceptions of preparedness to lead a workshop than non-participants (see Table 6). These workshops were: *CASTLE (Electricity), The Electromagnetic Spectrum, Energy-Societal Issues, Gravity, Interfacing-PASCO*, and *Interfacing-Vernier*.

There were no significant differences in the change in preparedness of participants and non-participants for the other workshops. There are a number of reasons that may explain the lack of differences. For some workshops, many participants indicated on the pre-institute questionnaire that they were already well prepared in the workshop topic before attending, leaving little room for growth. Similarly, many of the non-participating PTRAs regarded themselves as well prepared in the workshop topics, thus reducing the likelihood of detecting a significant difference between participants and non-participants. For other workshops, the small number of respondents decreases the likelihood of detecting a significant change.

[3] HRI was able to match the pre- and post-questionnaire responses of 52 PTRAs; some PTRAs submitted one, but not both questionnaires.

Table 6
PTRAs Feeling Well Prepared to Present Each of the Following Workshops, by Workshop Participation†

	Percent of PTRAs		
	N‡	Pre	Post
CASTLE (Electricity)*			
Participants	30	70	97
Non-Participants	18	72	61
The Electromagnetic Spectrum (NASA workshop)*			
Participants	17	82	88
Non-Participants	28	36	25
Energy			
Participants	12	25	92
Non-Participants	36	75	78
Energy – Societal Issues*			
Participants	21	29	86
Non-Participants	28	32	21
Graphical Analysis			
Participants	10	80	100
Non-Participants	39	72	74
Gravity*			
Participants	21	52	95
Non-Participants	30	67	40
Interfacing – PASCO*			
Participants	18	33	72
Non-Participants	29	28	38
Interfacing – Vernier*			
Participants	19	58	95
Non-Participants	27	48	59
Kinematics			
Participants	13	77	92
Non-Participants	34	97	97
Momentum and Impulse			
Participants	18	83	94
Non-Participants	28	82	86
Newton's 2nd Law			
Participants	10	70	90
Non-Participants	39	92	97

† Includes those who rated the item a 4 or 5 on a five-point scale from 1 "not adequately prepared" to 5 "very well prepared."

‡ By design, not all PTRAs participated in each workshop; the total number responding for each workshop to both the pre- and post-institute questionnaires is included in the table.

* The change in participants' perceptions of preparedness is statistically different than non-participants' change ($p < 0.05$).

When PTRAs did not feel well prepared to offer a workshop after participating in it during the institute, the post-institute questionnaire asked them to explain why the session did not better prepare them. The most common response, given by 19 of the 36 PTRAs replying to this question, was that they needed more time to become familiar with the workshop activities. Of these 19, 12 specifically mentioned needing more experience with the technology used in the activities. The second most common reason for not feeling prepared, given by 12 PTRAs, was that they did not agree with the workshop structure or pedagogy. Two PTRAs wrote:

[Workshop title] needs time to sink in and work through. It was well done, I just need time to allow the content to sink in.

The [title] workshop was a little too scattered and did not present a cohesive program to present to other teachers. I would have liked more time with the [workshop title] stuff…so that I would feel more comfortable with [it].

In an open-ended item on the post-institute questionnaire, PTRAs were asked to describe the single greatest impact the institute had on them. Twenty-six of the 53 respondents indicated an impact related to their classroom practice; 17 PTRAs specifically mentioned receiving activities to use in the classroom and 9 mentioned learning strategies for teaching students. As one PTRA wrote:

I have learned a lot that I can use to help my students, such as a new way to cover [topic] and some lessons I haven't used before.

In contrast, only 11 of the 53 responding PTRAs described an impact related to their abilities as a workshop leader. Of these, 8 indicated they gained new classroom activities to share in their outreach workshops. Only 3 mentioned learning strategies for working with adults. Similarly, the 10 interviewed PTRAs where asked what they gained from the summer institute. Four described learning teaching ideas to use in their classroom; three PTRAs mentioned learning workshop facilitation strategies. Given the heavy focus of the institute on classroom activities, it is not surprising that the PTRAs indicated that the greatest impact of the institute was improving their abilities as a classroom teacher.

Still, even PTRAs who felt that the *greatest* impact was on their abilities as classroom teachers may have been impacted in other areas. Thus, HRI asked a number of questions specifically about the impacts of the institute on the PTRAs as professional development providers. The most common response to a question asking what they had learned that would help them in this role, given by 20 of the 47 responding PTRAs, was learning strategies for working with adults. However, 8 of these 20 indicated that the strategies for working with adults were modeled, but not discussed, which left it up to the individual PTRAs to determine what the key aspects of the strategy were. As one PTRA wrote:

The presenters modeled the techniques of presenting effective workshops, but we did not really go into the theory.

Other impacts included familiarizing the PTRAs with the AAPT/PTRA manuals and exposing them to the content to be addressed in the rural institutes (mentioned by 8 and 7 PTRAs, respectively). Seven PTRAs indicated that the institute had no impact on them as professional development providers, as it did not contain explicit discussions of professional development strategies, questioning techniques to use with adults, or the research on how people learn.

The PTRAs were also asked a series of questions on the pre- and post-institute questionnaires regarding their attitudes and preparedness to lead professional development. These items were combined into three composite variables to reduce the unreliability associated with individual survey items. (Definitions of the composite variables, a description of how they were created, and reliability information are included in Appendix A.) Each composite has a minimum possible score of 0 and a maximum possible score of 100. A score of 0 would indicate that a participant selected the lowest response option for each item in the composite, whereas a score of 100 would indicate that a participant selected the highest response option for each item.

The first composite measures PTRAs' attitudes about the importance of a number of aspects of professional development, including developing teachers' understanding of important physics content, and when and why to use an activity within their science curriculum. The second composite measures PTRAs' feelings of preparedness to do these activities in their workshops. The third composite includes items relating to PTRAs' preparedness to provide professional development in a variety of formats, such as leading a multi-day outreach institute focused on one or two core physics topics and planning workshop activities to meet the needs of outreach participants from a wide range of backgrounds.

By linking PTRAs' responses from the pre- and the post-institute questionnaires, HRI is able to examine changes in these composite scores. As can be seen in Table 7, these data indicate that even before the institute the PTRAs scored highly on these composites. The data also show that the PTRAs' scores on these composites increased significantly after participating in the summer institute, another indication that the project is having an impact on the PTRAs. Effect sizes[4] for these changes are 0.22 standard deviations for the attitudes composite, 0.71 standard deviations for the preparedness to provide professional development composite, and 0.75 standard deviations for the preparedness to provide professional development in a variety of formats composite.

Table 7
PTRAs' Composite Scores

	Pre		Post	
	Mean	**Standard Deviation**	**Mean**	**Standard Deviation**
Attitudes about Professional Development	90.33	9.12	92.40*	7.92
Preparedness to Provide Professional Development	78.51	16.31	87.36*	13.47
Preparedness to Provide Professional Development in a Variety of Formats	72.08	17.22	82.26*	12.30

* Post-questionnaire score significantly greater than pre-questionnaire score, $p < 0.05$.

At the same time, from 4 to 21 percent of the PTRAs scored below 75 percent on these composites, and interviews with PTRAs and observations of PTRAs facilitating their rural institutes also provide evidence that some PTRAs do not feel well prepared to work with outreach participants. Observations of rural institutes parallel those of the PTRA institute. A majority of the time was spent having participants work through classroom activities as if they were students. As the PTRAs have reported that a substantial portion of outreach participants in the rural institutes do not have a strong grasp of the physics content, having teachers work

[4] Effect sizes of about 0.20 are typically considered small, 0.50 medium, and 0.80 large. Cohen, J. (1988). *Statistical Power Analysis for the Behavioral Sciences.* Hillsdale, NJ: Lawrence Erlbaum Associates.

through the activities is an effective strategy for teaching them the content. HRI also observed PTRAs discussing logistical issues regarding classroom implementation of the activities, though this type of discussion occurred less frequently. However, HRI rarely saw PTRAs moving the discussion beyond physics content or the logistics of implementing a classroom activity.

While improving teachers' content knowledge and raising their awareness of instructional resources is necessary for improving the teaching and learning of physics, it is probably not sufficient for having the magnitude of impacts to which the project aspires. Understanding what ideas (both correct and incorrect) students are likely to have prior to instruction and the implications of those ideas for teaching and learning are examples of the type of knowledge (often termed "pedagogical content knowledge") teachers need to be effective. Given that the PTRAs already have a great deal of experience sharing classroom activities with teachers, the project may want to increase the emphasis on pedagogical content knowledge throughout the summer institute and decrease the emphasis on classroom activities. In order to be successful, the PTRAs will need opportunities to practice and receive feedback on incorporating these types of activities and discussions into their workshops.

Data collected on the post-institute questionnaire support both the need, and the PTRAs' desire, for the summer institute to include a greater focus on pedagogical content knowledge and on effective professional development. The PTRAs were asked again the extent to which they needed leadership training in a number of areas. It was originally hypothesized that participation in the PTRA summer institute would decrease PTRAs' need for additional training. As can be seen in Table 8, even after attending the institute, many PTRAs indicated they would benefit from additional training in areas that would help them as a professional development leader (i.e., effective professional development strategies, research on misconceptions/student thinking in physics). The lack of a decrease in many of these areas, and a significant increase in the need for additional training in the research on common misconceptions/student thinking in physics, may be an indication that the PTRAs are beginning to realize that being an effective professional development provider requires them to do more than share classroom activities with teachers.

Table 8
PTRAs Indicating a Substantial Need† for Additional Leadership Training

	Percent of Respondents (N = 52)		
	Pre‡	**Post**	**Difference**
The research on common misconceptions/student thinking in physics	22	48	26*
The research on the principles of effective professional development	32	48	14
Strategies for implementing the principles of effective professional development in workshops for other teachers	35	48	13
The research on how people learn	37	42	5
Technologies for physics instruction	24	24	0
Activities for physics instruction	12	8	-4
Physics content	13	8	-5

† Includes those who rated the item 4 or 5 on a five-point scale from 1 "I don't need any additional training" to 5 "I could use a lot of additional training."

‡ The pre-institute percents shown here are different than those shown in Table 2 as this table includes responses only from those PTRAs that completed both a pre- and post-institute questionnaire.

* Indicates a significant change in PTRAs' perceived need for additional training ($p < 0.05$).

These data are supported by PTRAs' responses to an open-ended item on the post-institute questionnaire that asked what additional training would be helpful in preparing them for their role as a professional development provider. The most common request was for more training on how to facilitate professional development, given by 17 of the 41 PTRAs responding to this question. Ten of the respondents requested more information on how students learn physics/common misconceptions, 7 indicated they wanted more information on physics education research in general, and 6 asked for specific information on running a rural institute (e.g., timelines). Examples of comments made by PTRAs include:

> *I need more help to learn how to help other teachers become reflective practitioners without seeming to be arrogant. I want to help people think about student misconceptions and how to ask probing open-ended questions to students.*

> *I would like to learn more about the principles of effective professional development and what strategies are available to use to implement them in workshops for other teachers.*

> *[I want] more practice with modeling. More about adult learners, since they're very different from high school students.*

> *I would like to have a better understanding of what research tells about professional development [and] how to implement these findings.*

On both the post-institute questionnaire and during interviews, PTRAs were asked what aspects of the institute could have been better. Other than issues with the institute facilities (i.e., dorms, meals, etc.), the most common responses, mentioned by 10 of the 40 respondents on the post-institute questionnaire and 4 of the 10 interviewees, was a request for more information on facilitating outreach workshops and on the educational research on student thinking in physics. The PTRAs asking for these improvements in their training often made suggestions as to how to incorporate them into the institute. For example:

> *Bring a group of rural teachers from areas we don't serve and have us spend a day each helping them and helping us show we can do a workshop.*

> *Bring in some physics education research folks and let us get information from leaders in the field.*

> *We could do much more with talking about physics education research and what we are hoping the teachers take back from our workshops and how that interacts with what students are thinking…we should look at the manuals we already have and look about how to incorporate that [into the manuals].*

Implications

Looking across the data on the summer institute and its impacts on the PTRAs provides some valuable insights into the preparation of the PTRAs for their role as professional development providers. First, the PTRAs are primarily approaching the summer institute with the mindset of a classroom teacher, looking for activities and teaching strategies to use in their classrooms. The data also show that the summer institute was well-aligned with this mindset; large portions of the workshops were spent working through the student activities in the AAPT/PTRA manuals. Predicatively, the PTRAs reported that the greatest impact of the institute was their gaining activities and strategies to use in their classroom teaching.

Another theme that emerged from the data is that the PTRAs have a desire to incorporate more of the physics education research and what is known about best practices in professional development into their outreach workshops. Given the vital role the institute workshops play in preparing the PTRAs, the project leadership may need to expend a greater effort ensuring that the summer institute workshops incorporate opportunities for the PTRAs to learn and hone these types of skills. PTRAs, like most people, tend to teach as they were taught. If the summer institute workshops focus on working through classroom activities, it is not surprising that the PTRAs' outreach workshops have the same focus.

There are a number of approaches the leadership could take to increase the emphasis on leadership in the summer institute workshops. One possibility would be to ask the summer workshop leaders to annotate each classroom activity with the relevant research on student misconceptions, a description of how the activity addresses those misconceptions, and an explanation of how the activity contributes to the conceptual development of important physics ideas. Another possibility is to have the summer workshop leaders reduce the number of activities they work through with the PTRAs and devote more time to developing the PTRAs' professional development provider skills. For example, the leaders might want to have the PTRAs examine samples of student work and practice leading discussions around them. The leaders could then, along with the other participants, provide constructive feedback to the PTRAs on their leadership skills. Given that the PTRAs have requested a greater emphasis on the physics education research and what is known about effective professional development, it is likely that a well implemented shift in the emphasis of the institute would be welcomed by the PTRAs.

2004 Rural Institutes

As noted earlier, the main goals of the AAPT/PTRA Rural project focus on improving the teaching and learning of physics/physical science in rural classrooms via the rural regional centers. The project's model is for each center to host a 30-hour summer institute, and two, six-hour follow-up sessions during the school year. The summer institute is intended to focus on a small number of physics topics and provide outreach participants the opportunity for in-depth study of both the physics content and teaching strategies. The two follow-up sessions are intended to give outreach participants an opportunity to revisit the topic and reflect upon their attempts to incorporate what they learned into their classroom teaching.

Each rural regional center operates in conjunction with a local university and has a designated Rural Regional Coordinator, typically a member of the university's physics department. The coordinator's responsibilities include recruiting outreach participants, arranging facilities and equipment for the institutes, and managing all of the necessary paperwork. The coordinator makes it possible for the PTRAs to focus their energies on designing and implementing the professional development.

This section of the report describes the quality and impacts of the 2004 rural institutes. Data come from project records of participant attendance, a questionnaire administered to all rural institute participants, HRI's observations of portions of two rural institutes, pre-institute questionnaire responses from PTRAs who led rural institutes, and focus group interviews with a sample of Lead PTRAs.

Participation in the Rural Institutes

The AAPT/PTRA Rural project operated 25 rural regional centers during its third year. Three of the centers were continuations of "prototype" institutes created to test the logistics of this model prior to NSF funding, one center was initiated in the project's first year, seven in the second year, and 14 in the third year of NSF funding. Table 9 shows the number of outreach participants attending each of the rural institute summer and follow-up sessions.[5] Overall, 521 teachers attended the rural institutes; 59 percent attended a follow-up session during the school year. Fifty-six percent of the outreach participants reached the goal of 36 hours of professional development during a year.

The lower attendance at the follow-up workshops can be explained, in part, by the difficulty of finding a meeting time that works for all participants in a rural center. Another issue is that some participants are located hundreds of miles from the rural center, making travel for a one-day workshop too difficult. If the project believes the follow-up workshops are an important part of the professional development, it will need to seek ways to increase attendance at these sessions. Given that some centers have higher rates of participation in the follow-up sessions, the project may want to create a mechanism for center leaders to share strategies they have found effective for boosting attendance.

[5] Participation data come from AAPT/PTRA Rural project records and are current as of March 28, 2005.

Table 9
Outreach Participants Attending each Session, by Rural Regional Center

	Number of Outreach Participants		
	Summer Rural Institute	Any Follow-Up Session‡	At Least 36 Hours of Professional Development
Brigham Young University	14	14	14
Central Pennsylvania	22	13	13
Coastal Carolina University†	24	0	0
Colby College	20	17	17
Colgate University	25	20	20
Colorado School of Mines	7	6	6
Eastern Kentucky University	20	7	5
Emporia State University	22	17	17
Frostburg State University	19	0	0
Georgia College and State University	22	18	18
Gonzaga University	15	0	0
Idaho State University	43	36	36
Illinois State University†	16	0	0
James Madison University	20	17	16
Lee College	15	16	14
Montana State University	21	13	13
Ohio State University	18	15	13
Saginaw Valley State University	25	21	19
South Dakota State University†	24	10	9
State University of New York – Fredonia	17	13	13
Texas A&M University	28	0	0
Texas Tech University	36	29	26
University of Pittsburg – Bradford	20	11	10
University of Wisconsin – River Falls	14	8	8
Youngstown State University	14	7	6
Total	**521**	**308**	**293**

† "Prototype" center
‡ The length of follow-up workshops varied between two-hour sessions on single days and 12-hour sessions on two days.

In addition to the goal of providing at least 36 hours of professional development to participants per year, the project has the larger goal of providing at least 108 hours of professional development over the course of three years. By combining participant data from the past several years, it is possible to examine the project's progress towards reaching this goal. As can be seen in Table 10, only 23 of the 162 outreach participants in centers that have existed for three years have reached the goal of 108 hours of professional development. However, it is encouraging that the third cohort of sites (those that began in 2003) has been much more successful at retaining participants for a second year.

Table 10
Retention Rates for Rural Regional Centers, by Inaugural Year of the Center

	Number of Outreach Participants			
	Inaugural Year of Rural Regional Center			
	2001†	2002	2003	2004
1 Rural Institute Attended	68	25	58	271
2 Rural Institutes Attended	35	11	136	—
3 Rural Institutes Attended	16	7	—	—
Total	**119**	**43**	**194**	**271**

† "Prototype" centers

The Outreach Participants

An outreach participant questionnaire administered at the beginning of each rural institute collected a variety of information on the outreach participants. Since the questionnaires were administered on-site at the beginning of each institute, a 100 percent response rate was achieved. As can be seen in Table 11, half of the outreach participants were female and nearly all were white. Eighty-three percent taught high school during the 2003–04 academic year. Eighty-five percent of the participants taught physics and/or physical science; 64 percent taught physics, and over 55 percent taught physical science. Given the project's target audience of rural teachers, it is not unexpected that 70 percent of the outreach participants taught other science subjects and more than 1 in 4 taught non-science classes.

Table 12 shows the number of semesters of college coursework completed by the outreach participants. Forty-three percent of the outreach participants have taken eight or more college semesters of physics/physical science while 30 percent have taken three or fewer semesters. These data indicate that there is a broad range of content backgrounds among participants.

Table 11
Demographic Data for Outreach Participants

	Percent of Participants
Gender	
Male	49
Female	51
Race	
White	94
Black or African-American	3
American Indian or Alaskan Native	1
Asian	1
Hispanic or Latino	1
Native Hawaiian or Other Pacific Islander	0
Grade Level Taught†	
High School	83
Middle School	25
Elementary School	3
Not a Classroom Teacher	5
Prior Teaching Experience	
0–2 Years	15
3–5 Years	16
6–10 Years	22
11–20 Years	28
21 or More Years	19
Teaching Assignment Includes†	
Physics	64
Physical Science	55
Other Science	70
Non-Science	28

† Percents may add to more than 100 as participants could select more than one category.

Table 12
Outreach Participants' College Coursework

	Percent of Participants			
	0 Semesters	1–3 Semesters	4–7 Semesters	8 or More Semesters
Life Science/Biology	10	30	14	45
Chemistry	8	25	23	45
Physics/Physical Science	5	25	26	43
Mathematics	1	28	30	40
Earth/Space Science	22	42	18	19
Engineering/Technology	39	35	12	14

The Quality and Impacts of the Rural Institutes

Most of the 2004 rural institutes took place prior to the 2004 PTRA institute. Thus, HRI was able to ask the PTRAs on the pre-institute questionnaire and during focus group interviews held during the summer institute about their work with rural outreach participants. On an open-ended questionnaire item asking about the goals of the rural institutes, 47 of the 66 respondents indicated that a goal of their institute was to share classroom teaching strategies with participants; 34 mentioned working to deepen participants' knowledge of physics concepts. These goals were also the two most common ones described during focus group interviews with Lead PTRAs. This PTRA's comment is typical:

> *Teachers participating in workshops I help lead should develop more confidence in their own understanding of important physics concepts and how to help their students learn them.*

HRI's observations at two centers indicate that the institutes focused heavily on having the outreach participants work through student activities, with the goal of deepening their physics content knowledge. The goal of increasing outreach participants' repertoire of teaching strategies appeared to occur to a lesser extent, and tended to consist of the outreach participants becoming familiar with the classroom activities in the AAPT/PTRA manuals. Although HRI observed some discussions of classroom strategies specific to teaching physics/physical science, the majority of the discussions focused on logistical issues related to the preparation and implementation of student activities.

PTRAs' comments on the successes from their rural institutes on the pre-institute questionnaire correlated with HRI's observations. Increasing participants' physics content knowledge and provided participants with classroom activities were each listed as successes of the rural institutes by 14 of the 28 PTRAs responding to this question. As these three PTRAs described:

> *Teachers in grades K–12 got a broader understanding of physics content. They will be using [the PTRA] materials in their classrooms.*
>
> *The mixture of classroom activities, technology, and discussion of concepts seems to reach almost everyone in one way or another.*
>
> *We've opened a lot of eyes. So many of our participants needed the physics concepts along with activities. We even straightened out lots of their misconceptions.*

During the focus group interviews, Lead PTRAs reported a variety of strategies which they found to be effective in helping them reach their goals for the rural institutes. The strategies mentioned by the PTRAs were aligned with four goals: deepening outreach participants' knowledge of content and pedagogy; formatively assessing participant understanding during the workshop; creating a supportive environment for participants; and improving the logistics and planning for the institute.

One strategy the Lead PTRAs found effective for deepening outreach participants' knowledge of content and pedagogy was holding explicit discussions about the pedagogy modeled by the PTRAs. Another was asking the outreach participants to wear different hats. For example, the PTRAs first had outreach participants consider an activity as a student, asking questions such as, "What did you find as far as looking at this from the students' perspective?" The Lead PTRA indicated that this approach allowed the participants to feel safe in voicing their understanding (or lack thereof) of the content. After considering an activity from a student's perspective, the

PTRAs asked the participants to think about the activity as a teacher, using questions such as, "Now, let's put our teacher hat back on…What did you find was a hassle from the perspective of concepts or the methods you might use to do that?"

Examples of strategies for formatively assessing outreach participants' understanding included starting each day with a review of the previous day, a question/answer session, or using short tasks (e.g., Tom Okuma's ranking tasks, problems based on physlets). One institute asked participants to keep a reflective journal in which they answered the following questions at the end of each day: "What did you learn today?" "What puzzled you?" and "Any comments?" The PTRAs then read and made non-judgmental comments in the journals, and used the participants' responses to help tailor the workshop for the next day.

Using cooperative games, having participants share teaching strategies, and working in teams to solve problems together outside of the workshop time (e.g., a take home project) were among the methods PTRAs shared for creating a supportive environment at their rural institutes. Suggestions Lead PTRAs had for improving the logistical side of a rural institute included involving multiple PTRAs in the planning and implementation of an institute, and grouping participants by level of need and working with the groups in different rooms. One institute used participants' strengths and weaknesses in content, pedagogy, and technology to group participants; each group contained someone strong in each area. Another workshop found it effective to keep switching groups around during the week.

PTRAs were also asked during focus group interviews and on the pre-institute questionnaire about any obstacles they may have encountered while working with teachers at their rural institutes. Most of the Lead PTRAs in the focus groups (9 of the 12) indicated that it is difficult to plan for and address the needs of teachers who teach at different grade levels and have varying levels of background knowledge/training in physics. This issue was also among the most common responses to this question on the pre-institute questionnaire, mentioned by 7 of the 30 responding PTRAs. Another seven PTRAs mentioned participant turnover as an obstacle to planning for the institute as they could not build upon work from the previous summer nor did they know their participants' strengths and weaknesses ahead of time.

The PTRAs offered a variety of suggestions for improvements they would make to their outreach institutes. During the focus group interviews, the Lead PTRAs were asked what they would do differently the next time they led a rural institute. Their responses fell into two categories: changes in logistics, and changes in the way they implement their workshops. Suggestions for logistical changes included having the same PTRAs year after year as they know the skill level and needs of the outreach participants; involving the Rural Regional Coordinator in the institute planning and implementation process; and collecting a refundable registration fee from outreach participants to reduce dropout.

The PTRAs also discussed changes they would like to make to their workshop content and pedagogy. These included supplementing the PTRA manuals with outside materials; making the pedagogy they use during the rural institute more explicit to the participants; and incorporating formative assessment activities to check whether participants are "getting it." One PTRA mentioned a desire to build in more connections between the daily activities and the overall storyline of the week's focus.

While the rural institutes, like all other teacher enhancement programs, can continue to improve, there is evidence that they are having an impact on participating teachers. The Outreach Participant Questionnaire asked the outreach participants about their opinions about science teaching, perceptions of content and pedagogical preparedness, and frequency of use of various teaching practices. These items were combined into six composite variables (see Appendix A).

By linking data across years, HRI is able to examine changes in these composite scores for participants completing the questionnaire on multiple occasions. Table 13 shows composite scores for participants with two data points.[6] The data indicate a significant increase in participants' perceptions of pedagogical preparedness across the two time points (an effect size of 0.24 standard deviations). Participants also report a significant increase in their frequency of use of investigative teaching practices and a significant decrease in their frequency of use of traditional teaching practices (effect sizes of 0.30 and -0.24 standard deviations, respectively). As the number of rural centers increases, the number of participants submitting questionnaires across the targeted, three-year time frame should increase considerably, allowing for a broader look at the impact of the project.

Table 13
Outreach Participants' Composite Scores

		Initial Year		Most Recent Year	
	N	Mean	Standard Deviation	Mean	Standard Deviation
Attitudes Toward *Standards*-Based Teaching	159	77.38	12.76	76.30	12.56
Pedagogical Preparedness*	151	52.66	17.09	55.91	15.95
Physics Preparedness	163	53.12	20.69	55.17	19.84
Traditional Teaching Practices*	91	67.99	15.21	64.81	14.09
Investigative Teaching Practices*	91	31.52	13.46	34.76	12.54
Investigative Classroom Culture	95	65.13	16.01	66.43	15.75

* Initial Year score significantly different than Most Recent Year score, $p < 0.05$.

Although the outreach participants' perceptions of their content preparedness have not changed significantly, results from a teacher content knowledge impact study indicate that the PTRA program is having a positive impact on participants' physics content knowledge[7]. The study took advantage of the different cohorts of rural institutes, using participants from the momentum and energy institutes as a control group for the kinematics and dynamics institutes (and vice versa). The assessment utilized contained four scales aligned with the topics covered in the

[6] Data for the teaching practice and investigative classroom culture composites are presented only for those participants whose teaching assignment did not change from one year to the next.

[7] For a full description of the study, see Banilower, E.R., & Fulp, S.L. (2005). Results of the 2004 AAPT/PTRA Rural Institute Teacher Impact Study. Chapel Hill, NC: Horizon Research, Inc.

institutes: kinematics, dynamics, momentum, and energy. In addition, the study examined whether changes in teacher test scores vary by teacher gender and grade-level taught.

The study found that the AAPT/PTRA rural institutes have had a positive impact on teachers' physics content knowledge. On each of the four test scales (kinematics, dynamics, momentum, and energy), controlling for pre-test scores and demographics, participants who had taken part in an institute on that topic scored significantly higher than participants who had not. The study also found that gender was not a significant factor in teacher learning, with the exception of dynamics, where males scored slightly higher on the post-test (controlling for pre-tests score) than females. Grade level taught was a significant factor on both the momentum and energy scales; even after controlling for pre-test scores, high school teachers scored higher on the post-test than elementary and middle school teachers. No differences were found for grade level taught on the kinematics or dynamics scales.

Implications

Two main themes emerge from the rural institute data. The first theme centers on retaining outreach participants. Of the 521 teachers who attended the rural institutes this year, 59 percent attended a follow-up session during the school year, and just 56 percent reached the goal of 36 hours of professional development during a year. In addition, only 23 of the 162 outreach participants in centers that have existed for three years have reached the goal of 108 hours of professional development. On a positive note, the third cohort of sites (those that began in 2003) has been much more successful than earlier cohorts at retaining participants for a second year. The project may want to foster opportunities for the Rural Regional Coordinators and Lead PTRAs to share ideas on these issues, perhaps by creating mechanisms for them to share strategies that has worked well.

The second theme deals with tailoring the rural institutes to the needs of the local teachers. The project is providing professional development to teachers with a wide range of backgrounds and needs. Nearly all of the interviewed and surveyed PTRAs stressed the difficulty of planning for and addressing the needs of teachers who teach at different grade levels and have varying levels of background knowledge/training in physics. The project may want to explore ways of gathering information from the rural institute participants, perhaps on the rural institute application form, regarding their comfort level with physics topics and the level and types of technology available to them at their schools. Given the commonality of this issue across sites, the project may also want to consider building opportunities into the PTRA institute for discussions around workshop planning and implementation strategies that have proven effective in addressing the diverse needs of the rural teachers.

Third, in order to maximize the project's impact on physics/physical science teaching and learning, the project may need to increase the focus during the rural institutes on developing outreach participants' pedagogical content knowledge. For example, it may be beneficial to include a greater focus on developing participants' questioning skills, knowledge of common student misconceptions, and ability to informally assess student understanding. Lead PTRAs in the focus groups commented on a desire to make the pedagogy they use during the rural institute more explicit to the participants and integrate formative assessment activities throughout their workshops. To increase the likelihood of success, it will be important to provide the PTRAs with opportunities to develop and practice the skills necessary to include these types of activities in the rural institutes.

Student Impact Study

In the summer of 2004, HRI and the AAPT/PTRA rural project leadership developed a study for investigating the impact of the AAPT/PTRA rural project on student achievement. The study focuses on student achievement in kinematics, dynamics, momentum, and energy. With the help of the project, HRI recruited 172 teachers to participate in the study. A random sample of 89 teachers, stratified by rural institute attended, was selected from the volunteers; 45 of the teachers participated in a kinematics and dynamics institute, and 44 participated in a momentum and energy institute.

The study utilizes a pre-test/post-test design, with teachers from the kinematics and dynamics institute serving as a comparison group for teachers from the momentum and energy institute (and vice versa). The 50-item assessment utilized in this study was developed jointly by HRI and the AAPT/PTRA leadership, and included some items from previously developed assessments such as Jim Minstrell's *Diagnoser* and Ron Thornton and David Sokoloff's *Force-Motion Concept Evaluation*.

Because HRI has not yet received data from some of the participating teachers, results of this study are not available for this report. HRI will provide the project a supplemental report when the results of the study are available.

Summary and Recommendations

The AAPT/PTRA Rural project has made much progress in its third year. The project successfully established an additional 14 Rural Regional Centers, and provided professional development to 521 teachers across 25 sites. The professional development appears to be having a positive impact on outreach participants' perceptions of pedagogical preparedness and their frequency of use of investigative teaching practices. Data from the teacher impact study also indicate that the project has had a positive impact on participants' physics content knowledge.

The project has also had an impact on the preparedness of the PTRAs, both as classroom teachers, and to a lesser extent, as professional development providers. PTRAs reported gaining activities and instructional strategies to use in the classroom both. PTRAs also reported a positive impact on their attitudes toward and preparedness to implement professional development.

Still, as is true with all teacher enhancement projects, there are areas in which the project has room to grow. The focus on classroom activities, including sharing activities and discussing the logistical implementation of the activities, appears to outweigh other goals at both levels of the project: the PTRA institute and the rural institutes. Although the PTRAs are becoming adept at using the classroom activities to teach outreach participants core physics topics, other aspects of science teaching critical to effective practice have not yet been fully integrated into PTRA-provided professional development. Given the project's target audience of under-prepared or cross-over physics/physical science teachers, making sure the PTRAs have the necessary knowledge and skills to address the content and pedagogical content knowledge needs of outreach participants is vitally important. In the spirit of a critical friend, HRI offers the following recommendations to the project.

- **The project should consider ways to increase the focus at the PTRA Summer Institute on working with adults in a professional development setting and decrease the focus on working with children in the classroom. This shift in focus needs to happen in both the training offered to the PTRAs by the project and in the PTRAs' understanding of their role at the Summer Institute.**

  The data show that the PTRAs are entering the institute with a focus on what they can apply to their practice as a classroom teacher. Further, the PTRAs reported that the greatest impact of the institute was on their classroom practice. However, the primary purpose of the summer institute is to prepare the PTRAs for their role as professional development providers in the outreach institutes. Given that the PTRAs expressed a desire both before and after the institute for more training in facilitating professional development, effective professional development strategies and physics education research, it would appear that the PTRAs still have the need and interest to grow in these areas.

  Just like students need opportunities to practice and receive feedback on the skills they are expected to master, the PTRAs need opportunities to practice and receive feedback on their professional development facilitation skills. Providing the PTRAs with these opportunities may require decreasing the focus on familiarizing PTRAs with classroom activities during the PTRA institute and increasing the focus on practicing and receiving feedback on leadership skills (e.g., leading discussions, informally assessing participants' understanding, helping outreach participants examine student work/focus on questioning strategies). These changes may require the project leadership to increase their work with the PTRA institute workshop leaders, helping them incorporate what is known from physics education research and the research on effective professional development.

- **The project should consider ways to increase the sharing of effective leadership strategies among PTRAs and Rural Regional Coordinators.**

  Both the PTRAs and the Rural Regional Coordinators bring a wealth of experience and knowledge about what has been successful, and not so successful, in the planning and implementation of outreach institutes. This knowledge covers a range of topics from leadership skills (e.g., how to help outreach participants improve their questioning strategies), to increasing the retention rates of the rural institute, to strategies for dealing with diverse audiences (e.g., high school and middle school teachers, those with a degree in physics and those who have never taken a physics course). Pulling that knowledge together into a format that is both accessible and useful to other institute leaders and planners will benefit not only the AAPT/PTRA Rural project but the greater professional development community as well.

The project may want to consider what mechanisms already exist for such sharing (e.g., the PTRA listserv), and what other mechanisms may be needed. Some additional mechanisms may include having Rural Regional Coordinators attend the PTRA institute, reformatting the sharing session at the PTRA institute to focus on the sharing of professional development strategies, and asking Lead PTRAs to videotape portions of their institutes to view and discuss at the PTRA institute. Once the mechanisms are in place, the project will need to consider ways to ensure they are used effectively. For example, the project may want to "seed the discussion" on the listserv by asking the PTRAs and Rural Regional Coordinators to respond to specific questions or scenarios. Similarly, the project may want to first videotape the institutes run by members of the leadership team and lead a critical, but constructive, discussion about the quality of the professional development. Increasing the use of these types of mechanisms will also help the PTRAs keep their focus on their roles as professional development providers rather than their roles as classroom teachers.

Appendix A
Analysis and Reporting of Questionnaire Data

To facilitate the reporting of large amounts of survey data, and because individual questionnaire items are potentially unreliable, groups of survey questions that measure similar ideas can be combined into "composites." Each composite represents an important construct related to science teaching or professional development. Cronbach's Coefficient Alpha is a measure of the reliability of a composite (i.e., the extent to which the items appear to be measuring the same construct). A Cronbach's Alpha of 0.6 is considered acceptable, 0.7 fair, 0.8 good, and 0.9 excellent.

Each composite is calculated by summing the responses to the items associated with that composite and then dividing by the total points possible. In order for the composites to be on a 100-point scale, the lowest response option on each scale was set to 0 and the others were adjusted accordingly; so for instance, an item with a scale ranging from 1 to 5 was re-coded to have a scale of 0 to 4. As a result, someone who marks the lowest point on every item in a composite receives a composite score of 0 rather than some positive number. It also assures that 50 is the true mid-point. The denominator for each composite is determined by computing the maximum possible sum of responses for a series of items and dividing by 100; e.g., a nine-item composite where each item is on a scale of 0–4 would have a denominator of 0.36.

PTRA Pre- and Post-Institute Questionnaire Composite Definitions

Table A-1
Attitudes about Professional Development

Questionnaire Composite	**Pre**	**Post**
Develop their own understanding of important physics concepts	Q11ai	Q8ai
Understand student thinking and/or common misconceptions related to important physics concepts	Q11bi	Q8bi
Examine science pedagogy/teaching strategies (e.g., white boarding, pair share) and when/why to use them	Q11ci	Q8ci
Understand when and why to use a particular activity within their science curriculum	Q11di	Q8di
Learn how to examine student work in order to assess student thinking and reflect on classroom practice	Q11ei	Q8ei
Identify/develop lessons aligned to learning goals and state and national standards	Q11fi	Q8fi
Develop effective questioning strategies to elicit student understanding	Q11gi	Q8gi
Informally assess student learning	Q11hi	Q8hi
Formally assess student learning	Q11ii	Q8ii
Number of Items in Construct	**9**	**9**
Reliability (Cronbach's Coefficient Alpha)	**0.83**	**0.79**

Table A-2
Preparedness to Provide Professional Development

Questionnaire Composite	Pre	Post
Develop their own understanding of important physics concepts	Q11ap	Q8ap
Understand student thinking and/or common misconceptions related to important physics concepts	Q11bp	Q8bp
Examine science pedagogy/teaching strategies (e.g., white boarding, pair share) and when/why to use them	Q11cp	Q8cp
Understand when and why to use a particular activity within their science curriculum	Q11dp	Q8dp
Learn how to examine student work in order to assess student thinking and reflect on classroom practice	Q11ep	Q8ep
Identify/develop lessons aligned to learning goals and state and national standards	Q11fp	Q8fp
Develop effective questioning strategies to elicit student understanding	Q11gp	Q8gp
Informally assess student learning	Q11hp	Q8hp
Formally assess student learning	Q11ip	Q8ip
Number of Items in Construct	**9**	**9**
Reliability (Cronbach's Coefficient Alpha)	**0.94**	**0.87**

Table A-3
Preparedness to Provide Professional Development in a Variety of Formats

Questionnaire Composite	Pre	Post
Lead a six-hour AAPT/PTRA outreach workshop	Q12a	Q7a
Lead a two- to five-day AAPT/PTRA outreach institute focusing on one or two core physics topics (e.g., kinematics and dynamics or energy and momentum)	Q12b	Q7b
Conduct a demonstration lesson in an outreach participant's classroom	Q12c	Q7c
Coach an outreach participant (i.e., observe and provide feedback on a lesson)	Q12d	Q7d
Provide on-going support to outreach participants via electronic media (e.g., email, listservs, on-line forums, etc.)	Q12e	Q7e
Plan workshop activities that meet the needs of outreach participants with a wide range of backgrounds (e.g., middle school physical science and high school physics teachers)	Q12f	Q7f
Number of Items in Construct	**6**	**6**
Reliability (Cronbach's Coefficient Alpha)	**0.86**	**0.83**

Outreach Participant Questionnaire Composite Definitions

Table A-4
Attitudes Towards *Stnadards*-Based Teaching

Questionnaire Composite	
Provide concrete experience before abstract concepts.	Q8ai
Develop students' conceptual understanding of science.	Q8bi
Make connections between science and other disciplines.	Q8di
Have students work in cooperative learning groups.	Q8ei
Have students participate in appropriate hands-on activities.	Q8fi
Engage students in inquiry-oriented activities.	Q8gi
Use computers.	Q8ji
Engage students in applications of science in a variety of contexts.	Q8ki
Use portfolios.	Q8mi
Use informal questioning to assess student understanding.	Q8ni
Number of Items in Construct	**10**
Reliability (Cronbach's Coefficient Alpha)	**0.75**

Table A-5
Pedagogical Preparedness

Questionnaire Composite	
Provide concrete experience before abstract concepts.	Q8ap
Develop students' conceptual understanding of science.	Q8bp
Take students' prior understanding into account when planning curriculum and instruction.	Q8cp
Make connections between science and other discipline.	Q8dp
Have students work in cooperative learning groups.	Q8ep
Have students participate in appropriate hands-on activities.	Q8fp
Engage students in inquiry-oriented activities.	Q8gp
Engage students in applications of science in a variety of contexts.	Q8kp
Use performance-based assessment.	Q8lp
Use portfolios.	Q8mp
Use informal questioning to assess student understanding.	Q8np
Lead a class of students using investigative strategies.	Q9a
Manage a class of students engaged in hands-on/project-based work.	Q9b
Help students take responsibility for their own learning.	Q9c
Recognize and respond to student diversity.	Q9d
Encourage students' interest in science.	Q9e
Use strategies that specifically encourage participation of females and minorities in science.	Q9f
Involve parents in the science education of their students.	Q9g
Number of Items in Construct	**18**
Reliability (Cronbach's Coefficient Alpha)	**0.91**

Table A-6
Physics Content Preparedness (Version A)

Questionnaire Composite	
Forces and motion	Q10a1
Energy	Q10a2
Light and sound	Q10a3
Electricity and magnetism	Q10a4
Modern physics (e.g., special relativity)	Q10a5
Formulating hypotheses, drawing conclusions, making generalizations	Q10b1
Experimental design	Q10b2
Describing, graphing, and interpreting data	Q10b3
Number of Items in Construct	**8**
Reliability (Cronbach's Coefficient Alpha)	**0.87**

Table A-7
Physics Content Preparedness (Version B)

Questionnaire Composite	
Kinematics (i.e., Motion)	Q10a1
Forces (i.e., gravitational, normal, friction, tension)	Q10a2
Newton's Laws	Q10a3
Linear Momentum	Q10a4
Energy (i.e., Thermodynamics)	Q10a5
Energy as a Societal Issue	Q10a6
Static Electricity	Q10a7
Direct Current Circuits	Q10a8
Formulating hypotheses, drawing conclusions, making generalizations	Q10b1
Experimental design	Q10b2
Describing, graphing, and interpreting data	Q10b3
Number of Items in Construct	**11**
Reliability (Cronbach's Coefficient Alpha)	**0.90**

Table A-8
Traditional Teaching Practices

Questionnaire Comosite	
Assign science/mathematics homework.	Q13m
Answer textbook/worksheet questions	Q14g
Review homework/worksheet assignments.	Q14h
Take short-answer tests (e.g., multiple choice, true/false, fill-in-the-blank).	Q14y
Number of Items in Construct	**4**
Reliability (Cronbach's Coefficient Alpha)	**0.68**

Table A-9
Investigative Teaching Practices

Questionnaire Composite	
Make formal presentations to the class.	Q14d
Engage in hands-on science activities.	Q14k
Design or implement their own investigation.	Q14m
Work on models or simulations.	Q14o
Work on extended science investigations or projects (a week or more in duration).	Q14p
Participate in field work.	Q14q
Write reflections in a notebook or journal.	Q14s
Work on portfolios.	Q14x
Number of Items in Construct	**8**
Reliability (Cronbach's Coefficient Alpha)	**0.76**

Table A-10
Investigative Classroom Culture

Questionnaire Composite	
Arrange seating to facilitate student discussion.	Q13d
Use open-ended questions.	Q13e
Require students to supply evidence to support their claims.	Q13f
Encourage students to explain concepts to one another.	Q13g
Encourage students to consider alternative explanations.	Q13h
Participate in discussions with the teacher to further science understanding.	Q14b
Work in cooperative learning groups.	Q14c
Share ideas or solve problems with each other in small groups.	Q14j
Number of Items in Construct	**8**
Reliability (Cronbach's Coefficient Alpha)	**0.80**

Appendix B

AAPT/PTRA: Pre-Institute Questionnaire

AAPT/PTRA: Post-Institute Questionnaire

Rural Institute Participant Questionnaire (Version A)

Rural Institute Participant Questionnaire (Version B)

AAPT/PTRA: Pre-Institute Questionnaire 2004

Instructions: This questionnaire is for all PTRAs who will be attending the AAPT/PTRA Institute in Sacramento. Please complete this form using a #2 pencil or a blue or black ink pen. Darken circles completely. Erase or white out any stray marks. For all open-ended questions, please avoid writing in the markings at the side and top of the page; you can use the back of the page if necessary. All of your responses will remain strictly confidential in that they will be reported only as group results.

Background and Expectations

1. Was physics or physical science part of your teaching assignment last year?

   ○ Yes ○ No ○ Did not teach last year (skip to question 3)

2. Which best describes the location of the school where you teach? (Darken one circle.)

   ○ Rural ○ Urban ○ Suburban

3. How many years have you been teaching physics/physical science? *Please enter this as a 2-digit number. For example, if 3 years, enter as 03; then fill in the corresponding circle in each column.*

0	0
1	1
2	2
3	3
4	4
5	5
6	6
7	7
8	8
9	9

4. In what year did you *originally* become a PTRA? (Darken one circle.)

○ 1985	○ 1988	○ 1994	○ 1997	○ 2000	○ 2003
○ 1986	○ 1992	○ 1995	○ 1998	○ 2001	○ 2004
○ 1987	○ 1993	○ 1996	○ 1999	○ 2002	

5. In which of the following organizations are you a member? (Darken all that apply.) ○ AAPT ○ NSTA

6. Are you: (Darken one circle.) ○ Male ○ Female

7. Which best describes you? (Darken one circle.)

   ○ African-American (not of Hispanic origin)
   ○ American Indian or Alaskan Native
   ○ Asian or Pacific Islander
   ○ Hispanic
   ○ White (not of Hispanic origin)
   ○ Other

PLEASE DO NOT WRITE IN THIS AREA

{PREID}

8. What do you hope to gain from the upcoming PTRA Summer Institute?

9. *Only for PTRAs attending the summer institute for the first time*: Please describe how you learned about the PTRA program.

Opinions and Preparedness

10. How well prepared do you feel to *conduct a workshop* for other teachers in each of the following areas? (Darken one circle on each line.)

	Not adequately prepared		Somewhat prepared		Very well prepared
a. Teaching about electricity (i.e., electrostatics, electric current, and circuits)	1	2	3	4	5
b. Teaching about the electromagnetic spectrum	1	2	3	4	5
c. Teaching about energy	1	2	3	4	5
d. Teaching about societal issues related to energy	1	2	3	4	5
e. Teaching about gravity	1	2	3	4	5
f. Teaching about kinematics	1	2	3	4	5
g. Teaching about momentum and impulse	1	2	3	4	5
h. Teaching about Newton's 2nd Law (i.e., dynamics)	1	2	3	4	5
i. Incorporating graphical analysis into physics teaching	1	2	3	4	5
j. Incorporating the use of PASCO computer interfacing devices into physics teaching	1	2	3	4	5
k. Incorporating the use of Vernier computer interfacing devices into physics teaching	1	2	3	4	5

PLEASE DO NOT WRITE IN THIS AREA

{PREID}

11. In the left section, please rate how **important** it is for teachers to do each of the following in a professional development program. In the right section, indicate how **prepared** you feel to help other teachers to do each one. (Darken one circle in each section on each line.)

	Importance					**Preparedness**				
	Not important		Somewhat important		Very important	Not adequately prepared		Somewhat prepared		Very well prepared
a. Develop their own understanding of important physics concepts	1	2	3	4	5	1	2	3	4	5
b. Understand student thinking and/or common misconceptions related to important physics concepts	1	2	3	4	5	1	2	3	4	5
c. Examine science teaching strategies (e.g., white boarding, pair share) and when/why to use them	1	2	3	4	5	1	2	3	4	5
d. Understand when and why to use a particular activity within their science curriculum	1	2	3	4	5	1	2	3	4	5
e. Learn how to examine student work in order to assess student thinking and reflect on classroom practice	1	2	3	4	5	1	2	3	4	5
f. Identify/develop lessons aligned to learning goals and state and national standards	1	2	3	4	5	1	2	3	4	5
g. Develop effective questioning strategies to elicit student understanding	1	2	3	4	5	1	2	3	4	5
h. Learn how to informally assess student learning	1	2	3	4	5	1	2	3	4	5
i. Learn how to formally assess student learning	1	2	3	4	5	1	2	3	4	5

12. How well prepared do you feel to do each of the following? (Darken one circle on each line.)

	Not adequately prepared		Somewhat prepared		Very well prepared
a. Lead a six-hour AAPT/PTRA outreach workshop	1	2	3	4	5
b. Lead a two- to five-day AAPT/PTRA outreach institute focusing on one or two core physics topics (e.g., kinematics and dynamics, or energy and momentum)	1	2	3	4	5
c. Conduct a demonstration lesson in an outreach participant's classroom	1	2	3	4	5
d. Coach an outreach participant (i.e., observe and provide feedback on a lesson)	1	2	3	4	5
e. Provide on-going support to outreach participants via electronic media (e.g., email, listservs, on-line forums, etc.)	1	2	3	4	5
f. Plan workshop activities that meet the needs of outreach participants with a wide range of backgrounds (e.g., middle school physical science and high school physics teachers)	1	2	3	4	5

PLEASE DO NOT WRITE IN THIS AREA

{PREID}

13. To what extent would additional training in each of the following areas help you to be a more effective professional development provider? (Darken one circle on each line.)

	I do not need any additional training	I could use a little additional training	I could use a moderate amount of additional training	I could use a good deal of additional training	I could use a lot of additional training
a. Physics content	1	2	3	4	5
b. Activities for physics instruction	1	2	3	4	5
c. Technologies for physics instruction	1	2	3	4	5
d. The research on common misconceptions/student thinking in physics	1	2	3	4	5
e. The research on how people learn	1	2	3	4	5
f. The research on the principles of effective professional development	1	2	3	4	5
g. Strategies for implementing the principles of effective professional development in workshops for other teachers	1	2	3	4	5

14. In general, what are your goals for the AAPT/PTRA outreach workshops you lead (i.e., what do you hope teachers will gain by participating)?

15. *Only for PTRAs who have conducted rural outreach institute workshops:* What successes have you had in your rural institute workshops?

16. *Only for PTRAs who have conducted rural outreach institute workshops*: What obstacles have you encountered as you worked with teachers in rural institutes?

THANK YOU!!

PLEASE DO NOT WRITE IN THIS AREA

{PREID}

AAPT/PTRA: Post-Institute Questionnaire 2004

Instructions: Please complete this form using a #2 pencil or a black or blue pen. Darken circles completely. Erase or white out any stray marks. For all open-ended questions, please avoid writing in the markings at the side and top of the page; you can use the back of the page if necessary. All of your responses will remain strictly confidential in that they will be reported only as group results.

1. Indicate whether/when you participated in each of the following sessions as a PTRA. (Darken all that apply on each line.)

	Have never participated	Participated in a previous year	Participated this year
a. Electricity (i.e., CASTLE)	○	○	○
b. The Electromagnetic Spectrum (i.e., NASA workshop)	○	○	○
c. Energy	○	○	○
d. Energy – Societal Issues	○	○	○
e. Graphical Analysis	○	○	○
f. Gravity	○	○	○
g. Interfacing – PASCO	○	○	○
h. Interfacing – Vernier	○	○	○
i. Kinematics	○	○	○
j. Leadership and Workshop Methods	○	○	○
k. Make and Take	○	○	○
l. Momentum and Impulse	○	○	○
m. Newton's 2nd Law (i.e., dynamics)	○	○	○

2. For the workshops you participated in this year, please explain why you selected them.

3. What was the single greatest impact the summer institute had on you (i.e., how have you changed as a result of the summer institute)?

PLEASE DO NOT WRITE IN THIS AREA

{POSTID}

4. *For the workshops you did participate in **this year***, please rate the quality of instruction in each. (Darken one circle on each line.)

	Did not participate this year	Poor				Excellent
a. Electricity (i.e., CASTLE)	0	1	2	3	4	5
b. The Electromagnetic Spectrum (i.e., NASA workshop)	0	1	2	3	4	5
c. Energy	0	1	2	3	4	5
d. Energy – Societal Issues	0	1	2	3	4	5
e. Graphical Analysis	0	1	2	3	4	5
f. Gravity	0	1	2	3	4	5
g. Interfacing – PASCO	0	1	2	3	4	5
h. Interfacing – Vernier	0	1	2	3	4	5
i. Kinematics	0	1	2	3	4	5
j. Leadership and Workshop Methods	0	1	2	3	4	5
k. Make and Take	0	1	2	3	4	5
l. Momentum and Impulse	0	1	2	3	4	5
m. Newton's 2nd Law (i.e., dynamics)	0	1	2	3	4	5

5. Indicate how well prepared you feel to present a workshop based on each of the following, regardless of whether you have participated in an AAPT/PTRA workshop on that topic. (Darken one circle on each line.)

	Not adequately prepared		Somewhat prepared		Very well prepared
a. Teaching about electricity (i.e., electrostatics, electric current, and circuits)	1	2	3	4	5
b. Teaching about the electromagnetic spectrum	1	2	3	4	5
c. Teaching about energy	1	2	3	4	5
d. Teaching about societal issues related to energy	1	2	3	4	5
e. Teaching about gravity	1	2	3	4	5
f. Teaching about kinematics	1	2	3	4	5
g. Teaching about momentum and impulse	1	2	3	4	5
h. Teaching about Newton's 2nd Law (i.e., dynamics)	1	2	3	4	5
i. Incorporating graphical analysis into physics teaching	1	2	3	4	5
j. Incorporating the use of PASCO computer interfacing devices into physics teaching	1	2	3	4	5
k. Incorporating the use of Vernier computer interfacing devices into physics teaching	1	2	3	4	5

6. For each of the workshops **that you attended this year in Sacramento** and feel relatively less well prepared to present, please note the workshop in the space below and explain why you think the session did not better prepare you.

PLEASE DO NOT WRITE IN THIS AREA

{POSTID}

7. How well prepared do you feel to do each of the following? (Darken one circle on each line.)

	Not adequately prepared		Somewhat prepared		Very well prepared
a. Lead a six-hour AAPT/PTRA outreach workshop	1	2	3	4	5
b. Lead a two- to five-day AAPT/PTRA outreach institute focusing on one or two core physics topics (e.g., kinematics and dynamics or energy and momentum)	1	2	3	4	5
c. Conduct a demonstration lesson in an outreach participant's classroom	1	2	3	4	5
d. Coach an outreach participant (i.e., observe and provide feedback on a lesson)	1	2	3	4	5
e. Provide on-going support to outreach participants via electronic media (e.g., email, listservs, on-line forums, etc.)	1	2	3	4	5
f. Plan workshop activities that meet the needs of outreach participants with a wide range of backgrounds (e.g. middle school physical science and high school physics teachers)	1	2	3	4	5

8. In the left section, please rate how **important** it is for teachers to do each of the following in a professional development program. In the right section, indicate how **prepared** you feel to help other teachers to do each one. (Darken one circle in each section on each line.)

	Importance					**Preparedness**				
	Not important		Somewhat important		Very important	Not adequately prepared		Somewhat prepared		Very well prepared
a. Develop their own understanding of important physics concepts	1	2	3	4	5	1	2	3	4	5
b. Understand student thinking and/or common misconceptions related to important physics concepts	1	2	3	4	5	1	2	3	4	5
c. Examine science pedagogy/teaching strategies (e.g., white boarding, pair share) and when/why to use them	1	2	3	4	5	1	2	3	4	5
d. Understand when and why to use a particular activity within their science curriculum	1	2	3	4	5	1	2	3	4	5
e. Learn how to examine student work in order to assess student thinking and reflect on classroom practice	1	2	3	4	5	1	2	3	4	5
f. Identify/develop lessons aligned to learning goals and state and national standards	1	2	3	4	5	1	2	3	4	5
g. Develop effective questioning strategies to elicit student understanding	1	2	3	4	5	1	2	3	4	5
h. Informally assess student learning	1	2	3	4	5	1	2	3	4	5
i. Formally assess student learning	1	2	3	4	5	1	2	3	4	5

PLEASE DO NOT WRITE IN THIS AREA

{POSTID}

9. To what extent did each of the following occur during the institute in Sacramento? (Darken one circle on each line.)

	Not at all				To a great extent
a. Learned physics content	1	2	3	4	5
b. Gained activities for physics instruction	1	2	3	4	5
c. Gained experience with technologies for physics instruction	1	2	3	4	5
d. Learned about the research on common misconceptions/student thinking in physics	1	2	3	4	5
e. Learned about the research on how people learn	1	2	3	4	5
f. Learned about the research on the principles of effective professional development	1	2	3	4	5
g. Learned strategies for implementing the principles of effective professional development into workshops for other teachers	1	2	3	4	5

10. Responses to question 9 will give us quantitative data on the extent to which each of the listed items occurred during the summer institute, but we'd really like to know "the rest of the story." Please explain in your own words what you gained as a result of your participation in this summer's AAPT/PTRA institute that will help you in your role as a **professional development provider**?

11. To what extent would additional training in each of the following areas help you to be a more effective professional development provider? (Darken one circle on each line.)

	I do not need any additional training	I could use a little additional training	I could use a moderate amount of additional training	I could use a good deal of additional training	I could use a lot of additional training
a. Physics content	1	2	3	4	5
b. Activities for physics instruction	1	2	3	4	5
c. Technologies for physics instruction	1	2	3	4	5
d. The research on common misconceptions/student thinking in physics	1	2	3	4	5
e. The research on how people learn	1	2	3	4	5
f. The research on the principles of effective professional development	1	2	3	4	5
g. Strategies for implementing the principles of effective professional development in workshops for other teachers	1	2	3	4	5

PLEASE DO NOT WRITE IN THIS AREA

{POSTID}

12. Responses to question 11 will give us quantitative data on which of the listed areas PTRAs may need additional training, but we'd really like to know, in your own words, what additional training you would find helpful in your role as a **professional development provider**. Please use the space below to comment.

13. What aspects of the entire institute in Sacramento were particularly good? This question refers only to the AAPT/PTRA institute, not the AAPT conference.

14. What suggestions do you have for improving the AAPT/PTRA summer institute?

15. Please use the space below for any other comments about the Rural AAPT/PTRA project.

THANK **YOU!!**

PLEASE DO NOT WRITE IN THIS AREA

{POSTID}

AAPT/PTRA 2004 Rural Institute Participant Survey (Version A)

Instructions: Please use a #2 pencil or a blue or black pen to complete this questionnaire. Darken circles completely, but do not stray into adjacent circles. Be sure to erase completely or white out any stray marks. Please remove the label before you return the completed questionnaire to the workshop leader to ensure the anonymity of your responses.

A. Teacher Demographic Information

1. Are you: ○ Male ○ Female

2. Race - Are you: (Darken one or more.)

○ American Indian or Alaskan Native
○ Asian
○ Black or African-American
○ Hispanic or Latino
○ Native Hawaiian or Other Pacific Islander
○ White

3. For how many days did you participate in last year's AAPT/PTRA rural institute, including both the summer institute (up to five days) and school year follow-ups (up to two days)?

○ 0 ○ 1 ○ 2 ○ 3 ○ 4 ○ 5 ○ 6 ○ 7

4. For each of the following subjects, please indicate (a) the number of semesters of college coursework you have completed, and (b) whether you are certified to teach it at the secondary level. (Darken one circle in each section on each line.)

	Number of semesters college coursework				Certified?	
	0	1-3	4-7	8 or more	Yes	No
a. Life Science/Biology	○	○	○	○	○	○
b. Earth/Space Science	○	○	○	○	○	○
c. Chemistry	○	○	○	○	○	○
d. Physics/Physical Science	○	○	○	○	○	○
e. Engineering/Technology	○	○	○	○	○	○
f. Mathematics	○	○	○	○	○	○

5. How many years have you taught prior to this school year? (Darken one circle.)

0-2	3-5	6-10	11-15	16-20	21-25	26 or more
○	○	○	○	○	○	○

6. Which of the following did you teach this past school year? (Darken each circle that applies.)

○ Did not teach any K-12 science (skip to question 8)
○ Elementary school science
○ Middle school science
○ High school science

7. How many sections of each of the following courses did you teach this past school year? (Darken one circle on each line.)

	0	1	2	3	4	5	6	7 or more
Physics (e.g., Regular, Honors, Advanced Placement)	○	○	○	○	○	○	○	○
Physical Science	○	○	○	○	○	○	○	○
Other Science	○	○	○	○	○	○	○	○
Other Non-Science	○	○	○	○	○	○	○	○

B. Teacher Opinions and Preparedness

8. In the left section, please rate each of the following in terms of its **importance** for effective science instruction in the grades you teach. In the right section, please indicate how **prepared** you feel to do each one. (Darken one circle in each section on each line.)

	Importance: Not important	Importance: Somewhat important	Importance: Fairly important	Importance: Very important	Preparation: Not adequately prepared	Preparation: Somewhat prepared	Preparation: Fairly well prepared	Preparation: Very well prepared
a. Provide concrete experience before abstract concepts.	○	○	○	○	○	○	○	○
b. Develop students' conceptual understanding of science.	○	○	○	○	○	○	○	○
c. Take students' prior understanding into account when planning curriculum and instruction.	○	○	○	○	○	○	○	○
d. Make connections between science and other disciplines.	○	○	○	○	○	○	○	○
e. Have students work in cooperative learning groups.	○	○	○	○	○	○	○	○
f. Have students participate in appropriate hands-on activities.	○	○	○	○	○	○	○	○
g. Engage students in inquiry-oriented activities.	○	○	○	○	○	○	○	○
h. Have students prepare project/laboratory/research reports.	○	○	○	○	○	○	○	○
i. Use calculators.	○	○	○	○	○	○	○	○
j. Use computers.	○	○	○	○	○	○	○	○
k. Engage students in applications of science in a variety of contexts.	○	○	○	○	○	○	○	○
l. Use performance-based assessment.	○	○	○	○	○	○	○	○
m. Use portfolios.	○	○	○	○	○	○	○	○
n. Use informal questioning to assess student understanding.	○	○	○	○	○	○	○	○
o. Use calculator/computer-based labs.	○	○	○	○	○	○	○	○
p. Use graphing calculators.	○	○	○	○	○	○	○	○

9. Please indicate how well prepared you feel to do each of the following. (Darken one circle on each line.)

	Not adequately prepared	Somewhat prepared	Fairly well prepared	Very well prepared
a. Lead a class of students using investigative strategies.	○	○	○	○
b. Manage a class of students engaged in hands-on/project-based work.	○	○	○	○
c. Help students take responsibility for their own learning.	○	○	○	○
d. Recognize and respond to student diversity.	○	○	○	○
e. Encourage students' interest in science.	○	○	○	○
f. Use strategies that specifically encourage participation of females and minorities in science.	○	○	○	○
g. Involve parents in the science education of their students.	○	○	○	○

10. Within science, many teachers feel better prepared to teach some topics than others. How well prepared do you feel to teach each of the following topics at the grade levels you teach, whether or not they are currently included in your curriculum? (Darken one circle on each line.)

	Not adequately prepared	Somewhat prepared	Fairly well prepared	Very well prepared
a. Physics				
1. Forces and motion	○	○	○	○
2. Energy	○	○	○	○
3. Light and sound	○	○	○	○
4. Electricity and magnetism	○	○	○	○
5. Modern physics (e.g., special relativity)	○	○	○	○
b. Scientific methods and inquiry skills				
1. Formulating hypotheses, drawing conclusions, making generalizations	○	○	○	○
2. Experimental design	○	○	○	○
3. Describing, graphing, and interpreting data	○	○	○	○

Questions 11-14 ask about your science teaching. Please answer for your first physics or physical science class of the day during this past school year. *If you did not teach physics or physical science*, please answer for your first science class of the day. *If you did not teach any science*, darken here ○ and skip the remainder of this questionnaire.

11. What was the subject of this class? (Darken one circle.)

- ○ Life science/Biology
- ○ Earth/Space science
- ○ Environmental science
- ○ Chemistry
- ○ Physics
- ○ Physical science
- ○ Integrated science
- ○ General science

12. What grade level was it? (Darken one circle.)

○ Elementary school science ○ Middle school science ○ High school science

13. About how often did **you** do each of the following in your science instruction in this class? (Darken one circle on each line.)

	Never	Rarely (e.g., a few times a year)	Sometimes (e.g., once or twice a month)	Often (e.g., once or twice a week)	All or almost all science lessons
a. Introduce content through formal presentations.	○	○	○	○	○
b. Demonstrate a science-related principle or phenomenon.	○	○	○	○	○
c. Teach science using real-world contexts.	○	○	○	○	○
d. Arrange seating to facilitate student discussion.	○	○	○	○	○
e. Use open-ended questions.	○	○	○	○	○
f. Require students to supply evidence to support their claims.	○	○	○	○	○
g. Encourage students to explain concepts to one another.	○	○	○	○	○
h. Encourage students to consider alternative explanations.	○	○	○	○	○
i. Allow students to work at their own pace.	○	○	○	○	○
j. Help students see connections between science and other disciplines.	○	○	○	○	○
k. Use assessment to find out what students know before or during a unit.	○	○	○	○	○
l. Embed assessment in regular class activities.	○	○	○	○	○
m. Assign science homework.	○	○	○	○	○
n. Read and comment on the reflections students have written in their notebooks or journals.	○	○	○	○	○

14. About how often did **students** in this class take part in each of the following types of activities as part of their science instruction? (Darken one circle on each line.)

	Never	Rarely (e.g., a few times a year)	Sometimes (e.g., once or twice a month)	Often (e.g., once or twice a week)	All or almost all science lessons
a. Participate in student-led discussions.	○	○	○	○	○
b. Participate in discussions with the teacher to further science understanding.	○	○	○	○	○
c. Work in cooperative learning groups.	○	○	○	○	○
d. Make formal presentations to the class.	○	○	○	○	○
e. Read from a science textbook in class.	○	○	○	○	○
f. Read other (non-textbook) science-related materials in class.	○	○	○	○	○
g. Answer textbook/worksheet questions.	○	○	○	○	○
h. Review homework/worksheet assignments.	○	○	○	○	○
i. Work on solving a real-world problem.	○	○	○	○	○
j. Share ideas or solve problems with each other in small groups.	○	○	○	○	○
k. Engage in hands-on science activities.	○	○	○	○	○
l. Follow specific instructions in an activity or investigation.	○	○	○	○	○
m. Design or implement their *own* investigation.	○	○	○	○	○
n. Design objects within constraints (e.g., egg drop, toothpick bridge, aluminum boats).	○	○	○	○	○
o. Work on models or simulations.	○	○	○	○	○
p. Work on extended science investigations or projects (a week or more in duration).	○	○	○	○	○
q. Participate in field work.	○	○	○	○	○
r. Record, represent, and/or analyze data.	○	○	○	○	○
s. Write reflections in a notebook or journal.	○	○	○	○	○
t. Prepare written science reports.	○	○	○	○	○
u. Use mathematics as a tool in problem-solving.	○	○	○	○	○
v. Use calculators.	○	○	○	○	○
w. Use computers.	○	○	○	○	○
x. Work on portfolios.	○	○	○	○	○
y. Take short-answer tests (e.g., multiple choice, true/false, fill-in-the-blank).	○	○	○	○	○
z. Take tests requiring open-ended responses (e.g., descriptions, explanations).	○	○	○	○	○
aa. Engage in performance tasks for assessment purposes.	○	○	○	○	○

THANK YOU!!

PLEASE DO NOT WRITE IN THIS AREA

{FORMID}

AAPT/PTRA 2004 Rural Institute Participant Survey (Version B)

Instructions: Please use a #2 pencil or a blue or black pen to complete this questionnaire. Darken circles completely, but do not stray into adjacent circles. Be sure to erase completely or white out any stray marks. Please remove the label before you return the completed questionnaire to the workshop leader to ensure the anonymity of your responses.

A. Teacher Demographic Information

1. Are you: ○ Male ○ Female

2. Race - Are you: (Darken one or more.)

   ○ American Indian or Alaskan Native
   ○ Asian
   ○ Black or African-American
   ○ Hispanic or Latino
   ○ Native Hawaiian or Other Pacific Islander
   ○ White

3. For how many days did you participate in last year's AAPT/PTRA rural institute, including both the summer institute (up to five days) and school year follow-ups (up to two days)?

   ○ 0 ○ 1 ○ 2 ○ 3 ○ 4 ○ 5 ○ 6 ○ 7

4. For each of the following subjects, please indicate (a) the number of semesters of college coursework you have completed, and (b) whether you are certified to teach it at the secondary level. (Darken one circle in each section on each line.)

	Number of semesters college coursework				Certified?	
	0	1-3	4-7	8 or more	Yes	No
a. Life Science/Biology	○	○	○	○	○	○
b. Earth/Space Science	○	○	○	○	○	○
c. Chemistry	○	○	○	○	○	○
d. Physics/Physical Science	○	○	○	○	○	○
e. Engineering/Technology	○	○	○	○	○	○
f. Mathematics	○	○	○	○	○	○

5. How many years have you taught prior to this school year? (Darken one circle.)

0-2	3-5	6-10	11-15	16-20	21-25	26 or more
○	○	○	○	○	○	○

6. Which of the following did you teach this past school year? (Darken each circle that applies.)

   ○ Did not teach any K-12 science (skip to question 8)
   ○ Elementary school science
   ○ Middle school science
   ○ High school science

7. How many sections of each of the following courses did you teach this past school year? (Darken one circle on each line.)

	0	1	2	3	4	5	6	7 or more
Physics (e.g., Regular, Honors, Advanced Placement)	○	○	○	○	○	○	○	○
Physical Science	○	○	○	○	○	○	○	○
Other Science	○	○	○	○	○	○	○	○
Other Non-Science	○	○	○	○	○	○	○	○

B. Teacher Opinions and Preparedness

8. In the left section, please rate each of the following in terms of its **importance** for effective science instruction in the grades you teach. In the right section, please indicate how **prepared** you feel to do each one. (Darken one circle in each section on each line.)

	Importance: Not important	Importance: Somewhat important	Importance: Fairly important	Importance: Very important	Preparation: Not adequately prepared	Preparation: Somewhat prepared	Preparation: Fairly well prepared	Preparation: Very well prepared
a. Provide concrete experience before abstract concepts.	○	○	○	○	○	○	○	○
b. Develop students' conceptual understanding of science.	○	○	○	○	○	○	○	○
c. Take students' prior understanding into account when planning curriculum and instruction.	○	○	○	○	○	○	○	○
d. Make connections between science and other disciplines.	○	○	○	○	○	○	○	○
e. Have students work in cooperative learning groups.	○	○	○	○	○	○	○	○
f. Have students participate in appropriate hands-on activities.	○	○	○	○	○	○	○	○
g. Engage students in inquiry-oriented activities.	○	○	○	○	○	○	○	○
h. Have students prepare project/laboratory/research reports.	○	○	○	○	○	○	○	○
i. Use calculators.	○	○	○	○	○	○	○	○
j. Use computers.	○	○	○	○	○	○	○	○
k. Engage students in applications of science in a variety of contexts.	○	○	○	○	○	○	○	○
l. Use performance-based assessment.	○	○	○	○	○	○	○	○
m. Use portfolios.	○	○	○	○	○	○	○	○
n. Use informal questioning to assess student understanding.	○	○	○	○	○	○	○	○
o. Use calculator/computer-based labs.	○	○	○	○	○	○	○	○
p. Use graphing calculators.	○	○	○	○	○	○	○	○

9. Please indicate how well prepared you feel to do each of the following. (Darken one circle on each line.)

	Not adequately prepared	Somewhat prepared	Fairly well prepared	Very well prepared
a. Lead a class of students using investigative strategies.	○	○	○	○
b. Manage a class of students engaged in hands-on/project-based work.	○	○	○	○
c. Help students take responsibility for their own learning.	○	○	○	○
d. Recognize and respond to student diversity.	○	○	○	○
e. Encourage students' interest in science.	○	○	○	○
f. Use strategies that specifically encourage participation of females and minorities in science.	○	○	○	○
g. Involve parents in the science education of their students.	○	○	○	○

10. Within science, many teachers feel better prepared to teach some topics than others. How well prepared do you feel to teach each of the following topics at the grade levels you teach, whether or not they are currently included in your curriculum? (Darken one circle on each line.)

	Not adequately prepared	Somewhat prepared	Fairly well prepared	Very well prepared
a. Physics				
1. Kinematics (i.e., Motion)	○	○	○	○
2. Forces (i.e., gravitational, normal, friction, tension)	○	○	○	○
3. Newton's Laws	○	○	○	○
4. Linear Momentum	○	○	○	○
5. Energy (i.e., Thermodynamics)	○	○	○	○
6. Energy as a Societal Issue	○	○	○	○
7. Static Electricity	○	○	○	○
8. Direct Current Circuits	○	○	○	○
b. Scientific methods and inquiry skills				
1. Formulating hypotheses, drawing conclusions, making generalizations	○	○	○	○
2. Experimental design	○	○	○	○
3. Describing, graphing, and interpreting data	○	○	○	○

Questions 11-14 ask about your science teaching. Please answer for your first physics or physical science class of the day during this past school year. *If you did not teach physics or physical science*, please answer for your first science class of the day. *If you did not teach any science*, darken here ○ and skip the remainder of this questionnaire.

11. What was the subject of this class? (Darken one circle.)

○ Life science/Biology
○ Earth/Space science
○ Environmental science
○ Chemistry
○ Physics
○ Physical science
○ Integrated science
○ General science

12. What grade level was it? (Darken one circle.)

○ Elementary school science ○ Middle school science ○ High school science

13. About how often did **you** do each of the following in your science instruction in this class? (Darken one circle on each line.)

	Never	Rarely (e.g., a few times a year)	Sometimes (e.g., once or twice a month)	Often (e.g., once or twice a week)	All or almost all science lessons
a. Introduce content through formal presentations.	○	○	○	○	○
b. Demonstrate a science-related principle or phenomenon.	○	○	○	○	○
c. Teach science using real-world contexts.	○	○	○	○	○
d. Arrange seating to facilitate student discussion.	○	○	○	○	○
e. Use open-ended questions.	○	○	○	○	○
f. Require students to supply evidence to support their claims.	○	○	○	○	○
g. Encourage students to explain concepts to one another.	○	○	○	○	○
h. Encourage students to consider alternative explanations.	○	○	○	○	○
i. Allow students to work at their own pace.	○	○	○	○	○
j. Help students see connections between science and other disciplines.	○	○	○	○	○
k. Use assessment to find out what students know before or during a unit.	○	○	○	○	○
l. Embed assessment in regular class activities.	○	○	○	○	○
m. Assign science homework.	○	○	○	○	○
n. Read and comment on the reflections students have written in their notebooks or journals.	○	○	○	○	○

14. About how often did **students** in this class take part in each of the following types of activities as part of their science instruction? (Darken one circle on each line.)

	Never	Rarely (e.g., a few times a year)	Sometimes (e.g., once or twice a month)	Often (e.g., once or twice a week)	All or almost all science lessons
a. Participate in student-led discussions.	○	○	○	○	○
b. Participate in discussions with the teacher to further science understanding.	○	○	○	○	○
c. Work in cooperative learning groups.	○	○	○	○	○
d. Make formal presentations to the class.	○	○	○	○	○
e. Read from a science textbook in class.	○	○	○	○	○
f. Read other (non-textbook) science-related materials in class.	○	○	○	○	○
g. Answer textbook/worksheet questions.	○	○	○	○	○
h. Review homework/worksheet assignments.	○	○	○	○	○
i. Work on solving a real-world problem.	○	○	○	○	○
j. Share ideas or solve problems with each other in small groups.	○	○	○	○	○
k. Engage in hands-on science activities.	○	○	○	○	○
l. Follow specific instructions in an activity or investigation.	○	○	○	○	○
m. Design or implement their *own* investigation.	○	○	○	○	○
n. Design objects within constraints (e.g., egg drop, toothpick bridge, aluminum boats).	○	○	○	○	○
o. Work on models or simulations.	○	○	○	○	○
p. Work on extended science investigations or projects (a week or more in duration).	○	○	○	○	○
q. Participate in field work.	○	○	○	○	○
r. Record, represent, and/or analyze data.	○	○	○	○	○
s. Write reflections in a notebook or journal.	○	○	○	○	○
t. Prepare written science reports.	○	○	○	○	○
u. Use mathematics as a tool in problem-solving.	○	○	○	○	○
v. Use calculators.	○	○	○	○	○
w. Use computers.	○	○	○	○	○
x. Work on portfolios.	○	○	○	○	○
y. Take short-answer tests (e.g., multiple choice, true/false, fill-in-the-blank).	○	○	○	○	○
z. Take tests requiring open-ended responses (e.g., descriptions, explanations).	○	○	○	○	○
aa. Engage in performance tasks for assessment purposes.	○	○	○	○	○

THANK YOU!!