TEACHER LEADER INSTITUTES TO SUPPORT THE
DISSEMINATION OF ACTIVITY BASED PHYSICS TEACHING METHODS

NATIONAL SCIENCE FOUNDATION TEACHER ENHANCEMENT (NSF-TE)
PROGRAM GRANT NO. ESI-9819626

PROGRAM EVALUATION: FINAL REPORT

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EXECUTIVE SUMMARY

A. Background

Principle investigators Priscilla W. Laws, Patrick J. Cooney, John S. Garrett, David R. Sokoloff, Ronald K. Thornton, and Maxine C. Willis were awarded a National Science Foundation (NSF) grant titled Teacher Leader Institutes to Support the Dissemination of Activity Based Physics Teaching Methods on September 1, 1999 (NSF Grant No. ESI-9819626). The grant was awarded under the auspices of the Teacher Enhancement program (NSF-TE) to support four years of summer workshops under the rubric Activity Based Physics Institute (ABPI). The ABPI workshops were designed to help high school physics teachers introduce and refine activity-based teaching approaches to physics in their classrooms.

Approximately 115 teachers received four weeks of training each. This training was delivered in two-week workshops in each of two consecutive summers at Dickinson College in Carlisle, PA (2000-2001 and 2003-2004) and at the University of Oregon in Eugene, OR (2000-2001 and 2003-2004).

The purpose of the summative evaluation reported here is to provide information to the project managers and the NSF about the degree to which the workshop’s interactive teaching goals were achieved. Summative evaluation activities were conducted during the first three years of the four-year grant by Drs. Audrey Champagne and Eileen O’Connor. The author of this final report assumed responsibility for the evaluation in September of 2002 and conducted a comprehensive mail survey of all 115 ABPI participants in fall of 2003. The results of that survey (n=70; response rate of 61%) serve as a primary source of data for this evaluation.

B. Findings and recommendations

Data collected both during and after the ABPI workshops all support the conclusion that the ABPI program was extraordinarily successful in meeting its stated goals. Teacher-participants reported learning valuable teaching skills at the workshops and, subsequently, reported considerable successes in applying the activity-based approach to teaching physics at their home institutions.

The following chart summarizes the project's four principle goals alongside the findings and recommendations which flow from the data collected for this evaluation.

<table>
<thead>
<tr>
<th>Goals of principle investigators</th>
<th>Findings and recommendations of this evaluation</th>
</tr>
</thead>
</table>
| **Goal 1: Develop interactive teaching approaches using collaborative methods of inquiry which are consistent with national reform efforts.** | **Finding:** Participants were overwhelmingly satisfied with the approach to learning advanced by the ABPI workshops.  
**Recommendation:** Keep up the extraordinary work. |
| **Goal 2: Adapt and integrate research-based curricula and teaching methods into their courses.** | **Finding:** While participants were quite pleased with the training they got and the results they saw in the classroom, the issue of "time" came up again and again as a key constraint.  
**Recommendation 1:** Orient activity-based physics materials and workshops to standardized curricula.  
**Recommendation 2:** Increase sensitivity to time constraints when developing and modifying ABP materials. |
Goal 3: Use advanced technology to assist in the development of transferable computer analysis and mathematical modeling skills.

Finding: Participants were overwhelmingly satisfied with the ABPI materials. At the same time, it became clear that lack of access to computers and apparatus is serving as a significant impediment for some teachers.

Recommendation 3: Devote more time to grant-writing in future workshops.

Goal 4: Provide leadership in helping other science and mathematics teachers use new curricular material and computer tools more effectively.

Finding: While it is clear that the ABPI workshops helped participants achieve considerable success on an individual basis, data on dissemination collected for this report suggest that more could be done to convert program participants into trainers of other teachers.

Recommendation 4: Develop materials and devote more time to dissemination training in future workshops.

Beyond the four relatively minor recommendations made, above, the principle investigators should be lauded for their accomplishments in the following areas:

- Workshop feedback. The ABPI workshop experience received extraordinarily positive marks, as did the high school CD the principle investigators developed and distributed to workshop participants.

- Classroom activity. The ABPI workshops were reported by survey respondents to be responsible for noteworthy shifts in utilization of classroom time. Teachers reported significant cuts in the amount of class time devoted to traditional lectures (from 51% to 31%), while boosting the amount of class time devoted to class interaction by an equivalent amount.

- Teacher confidence. Overall, 95% of respondents thought that activity-based approaches made them better teachers.

- Student performance. Participants reported that three-quarters of their students did as well or better with the activity-based approach to teaching physics learned via ABPI. More specifically,
  - 95% of participants reported that their students were generally receptive to activity-based teaching approaches;
  - 91% reported that their student became more receptive to activity-based teaching approaches with time; and,
  - 93% of respondents thought that activity-based teaching helped their students become more proficient with the material.

In the end, the strongest and most important finding of this evaluation has to do with the importance of continuing and redoubling the effort to reach high school instructors with the very effective activity-based approach and supporting materials the principle investigators already have in place. The time, energy, talents, and resources the principle investigators have brought to this effort appear to have paid dividends many times over. As such, these efforts seem clearly worthy of continued support.
# Table of Contents

## I. INTRODUCTION
   A. Background  
   B. Goals  
   C. Workshops  
   D. Formative evaluation  
   E. Summative evaluation  
   F. Methodology  
   G. Summary  

## II. OVERVIEW OF SURVEY RESPONDENTS
   A. Cohorts and sites  
   B. News about ABPI  

## III. SURVEY RESPONDENT DEMOGRAPHICS
   A. Teaching setting comparisons  
   B. Profile of teaching responsibilities  
   C. Course comparison  
   D. Scheduling  
   E. Class size  
   F. Teaching peers  

## IV. IMPLEMENTING ACTIVITY-BASED TEACHING IN THE CLASS ROOM
   A. Aids to implementation  
   B. *Activity Based Physics High School CD*  
   C. Two-year workshops  

## V. ABPI OUTCOMES
   A. Changes in allocation of classroom time  
   B. Teaching styles  
   C. Classroom outcomes  
   D. Implementation  
   E. Funding  
   F. Dissemination  

## VI. CONCLUSIONS AND RECOMMENDATIONS
   A. Time  
   B. Funding  
   C. Dissemination  
   D. Conclusion  

### APPENDIX I: Survey Administration
   - Full text survey as mailed to all participants  
   - Summary "short form" of the survey  
   - Initial contact letter (November 10, 2003); Follow-up contact letter (December 8, 2003)  
   - Pasco and Vernier coupons  

### APPENDIX II: Survey Responses
   - Respondent profiles  
   - Responses to open-ended questions  

### APPENDIX III: ABPI Workshop Materials
   - Workshop schedules for the East Coast workshop at Dickinson for 2000-01 and 2002-03  
   - Flyer announcing the Activity Based Physics Institutes (ABPI)  
   - Description of the *Activity Based Physics High School CD*  

### APPENDIX IV: Glossary of ABPI terms
List of Charts

I. INTRODUCTION
   Chart 1.1: Cohorts and workshop sites 7
   Chart 1.2: Most common home states of ABPI participants 7

II. OVERVIEW OF SURVEY RESPONDENTS
   Chart 2.1: Respondents 10
   Chart 2.2: Recruitment 11

III. SURVEY RESPONDENT DEMOGRAPHICS
   Chart 3.1: Comparison of ABPI and AIP respondents -- School setting (public only) 12
   Chart 3.2: Comparison of ABPI and AIP respondents – Teaching responsibilities and teacher profiles 13
   Chart 3.3: Courses and grade levels taught 14
   Chart 3.4: Class scheduling in respondents’ schools 15
   Chart 3.5: Smallest, largest, and most typical class sizes reported by respondents 15
   Chart 3.6: Number of colleagues at home institution 16

IV. IMPLEMENTING ABPI
   Chart 4.1: Aids to implementing activity-based teaching in the classroom 17
   Chart 4.2: “Other forms of guided inquiry” 18
   Chart 4.3: Aids to implementing activity-based teaching in the classroom -- High School CD 19
   Chart 4.4a, b, c, d, e: Learning attributable to each year of the 2-year workshop cycle 20

V. ABPI OUTCOMES
   Chart 5.1: Changes in class-time usage 21
   Chart 5.2: Distribution of changes in class-time usage 22
   Chart 5.3a: Teacher impressions of student reactions to activity-based teaching 23
   Chart 5.3b: Basis for teacher impressions of student reactions to activity-based teaching 23
   Chart 5.4: Classroom outcomes 24
   Chart 5.5: Student learning 25
   Chart 5.6: Key factors to implementation 25
   Chart 5.7: Key barriers to implementation 25
   Chart 5.8: Impediments and recommendations 26
   Chart 5.9: Funding 26
   Chart 5.10: Dissemination 27

VI. CONCLUSIONS AND RECOMMENDATIONS
   Chart 6.1: Goals, findings, and recommendations 32

APPENDIX II: Survey Responses
   Chart II.1: Respondent profiles 51
I. INTRODUCTION

A. Background

Principle investigators Priscilla W. Laws, Patrick J. Cooney, John S. Garrett, David R. Sokoloff, Ronald K. Thornton, and Maxine C. Willis were awarded a National Science Foundation (NSF) grant titled Teacher Leader Institutes to Support the Dissemination of Activity Based Physics Teaching Methods on September 1, 1999 (NSF Grant No. ESI-9819626). The grant was awarded under the auspices of the Teacher Enhancement program (NSF-TE) to support four years of summer workshops under the rubric Activity Based Physics Institute (ABPI). The ABPI workshops were designed to help high school physics teachers introduce and refine activity-based teaching approaches to physics in their classrooms.

The philosophy advanced by the workshop team was grounded on two principles.

- First, the workshops highlighted the important role that collaboration and self-discovery can play (a) in reaching students and deepening their understanding of physics concepts in general, as well as (b) in helping them make connections between what is taught in the classroom and physical phenomenon in the "real world."
- Second, the workshops highlighted the important role that technology (e.g., sensors with computer interfaces, graphing software, etc.) can play in allowing students to observe, measure, and analyze physical phenomena for themselves.

B. Goals

The goals of the ABPI workshops were specified in the grant application as follows:

- **Goal 1**: *Develop interactive teaching approaches* using collaborative methods of inquiry which are consistent with national reform efforts. These approaches will help institute participants become active learners, develop confidence in their ability to observe, experiment, analyze, and write about phenomena in physics and physical science and enjoy the learning process.
- **Goal 2**: *Adapt and integrate research-based curricula and teaching methods* into their courses in order to (a) create opportunities for all institute participants to meet local, state, and national standards, and (b) help participants learn how to evaluate the effectiveness of their curricular changes.
- **Goal 3**: *Use advanced technology*, including Microcomputer- and Calculator-Based Laboratory (MBL/CBL) tools, Visualizer, spreadsheets, graphing software, and video analysis software to help institute participants develop a firm understanding of the fundamental physics concepts, tackle real world problems, and acquire transferable computer analysis and mathematical modeling skills.
- **Goal 4**: *Provide leadership* in helping other science and mathematics teachers use new curricular material and computer tools more effectively.

C. Workshops

Approximately 30 high school physics teachers attended each of four workshops (115 teachers in all). The *East Coast* workshops at Dickinson College in Carlisle, PA were staffed by Priscilla Laws (Dickinson College), Patrick Cooney (Millersville University), and Maxine Willis (Gettysburg Area High School). The *West Coast* workshops at the University of Oregon in Eugene, OR, were staffed by David Sokoloff (University of Oregon), Ronald Thornton (Tufts University), and John Garrett (Science Education Consultant). Each workshop ran for two weeks in two consecutive summers at these two locations, as follows:
Participants were recruited from 26 states and American Samoa. About half the participants (51%) came from one of four states: Pennsylvania (24), Oregon (20), Texas (10), and Washington state (9). Illinois, New York, and Wisconsin contributed another 5 teachers, each. The remaining teachers came from the following states: CT (4), ID (4), MD (3), MN (3), CA (2), DE (2), KS (2), MA (2), ME (2), OH (2), VA (2), AK (1), FL (1), GA (1), KS (1), LA (1), MO (1), OK (1), RI (1), American Samoa (1).

The first week of each two-week session was designed to introduce activity-based teaching approaches, including introductions to:

- interactive lecture demonstrations (ILD's) and other interactive teaching modules;
- interfacing apparatus and graphing software that allows students to observe phenomena, take their own measurements, and do their own analysis;
- the use of whole-class discussions and demonstrations, pair and small group activity, and other forms of collaborative and guided inquiry; and
- RealTime Physics and WorkShop Physics materials.

The second two-week session of each workshop was designed to take stock of what successes were achieved and what road blocks had been encountered after the first year-session, with an eye toward building on successes and
working around impediments. In each year of the workshop, participants spent most of their time with hands-on activities. This first week of each summer workshop was mostly devoted to having teachers work through teaching modules that the principle investigators had already designed. The second week had the teachers working in small, self-selected groups to develop their own teaching modules, which were to be modeled on activity-based teaching principles learned during week one. (Schedules for the East Coast workshops can be found in Appendix III.)

D. Formative evaluation

Formative evaluation data was collected by the principle investigators through the course of the workshops. In addition to incidental feedback acquired while working side-by-side workshop participants, principle investigators took a more formal sounding of reactions to the material and methods being presented via regular on-line surveys, conducted after hours during the course of each workshop. Participants presented course modules at the end of each two-week session, and that served as another form of feedback for the ABPI faculty. Finally, participants were asked to complete more comprehensive surveys at the end of each workshop session. The online data helped the investigators track successes and identify areas in need of improvement in real time, day-to-day as the workshops unfolded. The end-of-workshop presentations and evaluations provided a basis for more substantive corrective actions in the time between summer workshops.

E. Summative evaluation

The purpose of the summative evaluation reported here is to provide information to the project managers and the NSF about the degree to which the four primary workshop goals were achieved (see B. Goals, above). Summative evaluation activities were conducted during the first three years of the four-year grant by Drs. Audrey Champagne and Eileen O’Connor. The author of this final report assumed responsibility for the evaluation project in September of 2002. Although he came to the project late in the process, the author was generally familiar with the workshops and their purposes, having conducted an evaluation of a very similar initiative by the same principle investigators in 1998.¹

F. Methodology

A comprehensive, confidential, 140-item mail survey (including 11 free-response questions) was administered to all 115 ABPI participants (see Appendix I). The results of that survey (n=70; response rate of 61%) serve as the primary source of information for this report. In addition, the following sources of information and data were reviewed to provide context and background, where applicable:

- Interim reports drafted by Champagne/O’Connor regarding the first three years of the ABPI.
- Information collected from an NSF meeting on program evaluation (Washington, DC: July 15-16, 2003).
- A sampling of previous work on activity based teaching approaches, including the following works:
  - *Women’s responses to an activity-based introductory physics program* (in *New Directions of Teaching and Learning*, Laws, Rosborough and Poodry; Jossey-Bass, Spring 1995); and,

Materials distributed to all participants, including:

- *Activity Based Physics High School CD* (Laws, Baumberger, Garrett, Willis; published by John Wiley & Sons, 2001; distributed by Vernier Software & Technology and PASCO Scientific);
- ABPI Workshop notebooks (with a variety of exercises included);
- Access the ABPI Blackboard web site; and,
- A guidebook titled *Teaching Physics with the Physics Suite* (second cohort only; Redish; published by John Wiley & Sons, 2003).

Formative evaluation commentary provided by participants (collected during workshops, at the conclusion of each workshop, and as part of the ABPI list-serv activity).

Selected final project papers delivered by workshop participants (2002).

Personal observations of at least part of each day of the workshop held at Dickinson College in Carlisle, PA, during the summer of 2003, including a number of informal conversations with various participants and staff during that time period.

G. Summary

The results of the data collected for this report suggest that not only did the workshops succeed in serving as a training ground for high school teachers, the workshops themselves modeled the collaborative, self-directed approach to technology-facilitated learning. Workshop participants left not only able to *talk the talk* about the collaborative, activity-based, technology-assisted approach to teaching high school physics -- they left with four weeks of experience *walking the walk* under their belts, as well.

This evaluation begins with an overview of the survey respondents (Section II), followed by a synopsis of respondent demographics (Section III). The next part of the report covers issues related to implementing activity-based teaching approaches in the classroom (Section IV), and that section is followed by a review of classroom outcomes traceable to participation in the ABPI initiative (Section V). The report closes with a set of conclusions and recommendations for future workshops (Section VI).
II. OVERVIEW OF SURVEY RESPONDENTS

A. Cohorts and sites

A total of 115 high school teachers participated in the Activity-Based Physics Institute (ABPI) workshops held at the University of Oregon (Eugene, OR) and Dickinson College (Carlisle, PA) during 2000-2001 and 2002-2003. The group was evenly split in the first round, with 29 teachers each in Eugene and Carlisle in 2000-2001. Another 30 teachers in Eugene and 27 in Carlisle went through the second round of workshops in 2002-2003.

Chart 2.1: Respondents

- **Cohort**: About half of the 115 ABPI participants (58) attended the first session (2000-01) and about half (57) attended the second session (2002-03). As the first set of bars shows, the two cohort groups were proportionately represented in the respondent pool, with nearly a 50%-50% breakdown.

- **Sites**: About half of the 115 ABPI participants attended the ABPI at the University of Oregon site in Eugene, OR (59), and about half attended ABPI at the Dickinson College site in Carlisle, PA (56). As the second set of bars shows, the respondent pool approximates this 50%-50% breakdown, as well.

- **Note**: While the total number of respondents was 70 (an overall response rate of 70/115=61%), one participant attended the first year of the workshop at the Eugene site and the second year of the workshop at the Carisle location. That teacher is not represented in the chart, above, which is why the respondent data totals only 69 in each set of bars (cohorts and sites).
B. News about ABPI

Respondents reported hearing about the ABPI workshop in a variety of ways. The following chart depicts the methods by which news about the workshops was received.

Chart 2.2: Recruitment

- The data for cohort 1 (2000-01) sums to 112%, and for cohort 2 (2002-03) sums to 105%, suggesting some, but not much overlap among means of communication.
- "Word-of-mouth" and notices in the Physics Teacher publication seemed to be the most effective methods of getting the word out about the ABPI initiative. In both cases these methods were more effective with participants who attended the first cycle ('00-'01).
- Information from the web and from NSTA Reports were relatively more effective with participants who attended the second cycle ('02-'03).
- Note: While Vernier was not one of the listed options provided in the survey, 5 respondents wrote in Vernier as a means by which they found out about the ABPI initiative.

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2. Vernier Software and Technology specializes in the distribution of software and equipment that supports physics instruction at both the secondary and post-secondary levels. The ABPI was advertised in several editions of Vernier’s newsletter, The Caliper: http://www.vernier.com/caliper/fall01/workshops.html
III. SURVEY RESPONDENT DEMOGRAPHICS

A. Teaching setting comparisons

The American Institute of Physics (AIP) surveyed high school physics teachers and provided summary results in its 1999 report on the state of physics education in America. The following two charts compare ABPI survey respondents to AIP survey respondents on several key indicators in an effort to (1) describe the ABPI population in specific terms, and (2) establish the degree to which ABPI respondents were "typical" of the more general AIP population.

The first chart compares the physical setting of the schools where instructors from each of these two groups teach. Data for both ABPI and AIP respondents refers to teachers from public schools, only.

Chart 3.1: Comparison of ABPI and AIP respondents -- School setting (public only)

- The ABPI respondent pool was not particularly well-represented when it came to the rural school setting. While 60% of AIP respondents came from rural schools, only about half that many (31%) ABPI respondents reported teaching in a rural setting.

- Respondents to the ABPI survey tended to be overrepresented in the "small city/large town" and "large metro suburbs" categories.

B. Profile of teaching responsibilities.

The following chart compares the teaching responsibilities and experience levels of respondents of the ABPI survey with the 1999 survey of physics teachers conducted by the American Institute of Physics (AIP) in the following categories:

- The "Specialist" category refers to those with a physics degree and physics teaching experience.
- The "Career" category refers to those with no physics degree, but extensive physics teaching experience.
- The "Occasional" category refers to those with no physics degree and little physics teaching experience.

Chart 3.2: Comparison of ABPI and AIP respondents – Teaching responsibilities and teacher profiles

- **Teaching responsibilities.** Respondents to the ABPI survey were overrepresented by those who taught physics exclusively (39%) compared to those in the AIP respondent pool (19%). Conversely, ABPI respondents who taught mostly non-physics courses (17%) were underrepresented, when compared to the AIP group (49%). This distribution is understandable in that those who do more physics teaching (the ABPI cohort) would be more likely to seek out additional training and make a substantial investment of time (four weeks over two summers) on professional development activities.

- **Teaching roles.** ABPI and AIP respondents are fairly similar with regard to teaching experience. ABPI respondents were slightly more likely to be "career" teachers of physics, while AIP respondents were slightly more likely to describe their role as a physics teacher as falling in the "occasional" category.
C. Course comparison

The following chart represents the kinds of courses respondents to the ABPI survey reported teaching at their home institutions.

**Chart 3.3: Courses and grade levels taught**

- **Physics courses**: Respondents reported teaching mostly 11th- and 12th-graders, with *1st-Year Physics* the course most frequently taught (67%), followed by *Honors Physics* (30%) and *AP Physics* (27%), respectively. At the same time, nearly a quarter of the respondents reported teaching *Physical Science* to 9th-graders, and one in five respondents (21%) reported teaching *Conceptual Physics* to 11th-graders.

- **Other Sciences**: A significant number of respondents reported teaching math at some grade level (20% of respondents reported teaching at least one math class), and an even higher percentage reported teaching chemistry (27% of respondents reported teaching at least one chemistry class).
D. Scheduling

The following pie chart represents the breakdown of class scheduling formats in use at respondents' home institutions.

Chart 3.4: Class Scheduling in respondents’ schools (n=69)

- While it is commonly held that activity-based teaching methods are easiest to implement using a block scheduling format, only about a third of respondents report using this kind of schedule (35%).
- Meanwhile, nearly half of all respondents report that they operate under the more traditional "standard" form of class scheduling (relatively constrained class periods meeting every day, or most days of the week, throughout the school year).

E. Class size

The following chart displays data related to class size. The first set of bars indicates the smallest class an instructor tended to teach, the middle set of bars indicates a teacher’s typical class size, and the final set of bars shows the largest class a teacher normally taught.

Chart 3.5: Smallest, largest, and most typical class sizes reported by respondents

- Information about class size was collected as ordinal data (e.g., class size under 10, 11-15, 16-20, etc.), so it is impossible to report a mean number of students in each category (e.g., smallest, largest, and most typical class size). If one assumes a random distribution of class sizes in each ordinal category, however, a weighted mean for each category can be estimated:
  - Smallest class (estimated mean): 20 students
  - Typical class size (estimated mean): 23 students
  - Largest class size (estimated mean): 28 students
It is interesting to note that 20% of teachers reported never having a class smaller than 21 students, and that three out of five teachers (61%) taught at least one class of 26 or more students.

F. Teaching peers

The following chart provides information about how many peers survey respondents have at their home institutions.

**Chart 3.6: Number of colleagues at home institution**

- **Other physics teachers**: A clear majority of respondents (59%) are "solo practitioners" in that they are the only teachers of physics in their schools. Another quarter report having only one peer physics teacher.

- **Other science teachers**: Most respondents (57%) report having at least four other peers teaching in the sciences at their home institutions, while the balance (43%) have three or fewer teaching colleagues.

- **Other teachers interested in activity-based learning**: While a third of all respondents report that there were four or more teachers of science interested in activity-based teaching approaches in their schools, nearly one-quarter (23%) report that they were the only teachers in their schools interested in activity-based teaching and learning.
IV. IMPLEMENTING ACTIVITY-BASED TEACHING IN THE CLASS ROOM

A. Aids to implementation

The following chart lists various aids to implementing activity-based teaching approaches to physics that were covered in the ABPI workshop. Aids are generally listed in order from most helpful to least helpful.

Chart 4.1: Aids to implementing activity-based teaching in the classroom

"These features of the ABPI workshops were helpful in implementing activity-based teaching in my classroom. . . ."

<table>
<thead>
<tr>
<th>Aids to implementation</th>
<th>Strongly Agree</th>
<th>Agree</th>
<th>Mixed</th>
<th>Disagree</th>
<th>Disagree</th>
<th>Feelings</th>
<th>Total positive response %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Talks with other ABPI teachers</td>
<td>72%</td>
<td>67%</td>
<td>45%</td>
<td>27%</td>
<td>27%</td>
<td>99%</td>
<td></td>
</tr>
<tr>
<td>Instruction directed toward interfacing (MBL, CBL)</td>
<td>46%</td>
<td>46%</td>
<td>45%</td>
<td>27%</td>
<td>27%</td>
<td>94%</td>
<td></td>
</tr>
<tr>
<td>Interactive Lecture Demonstrations (ILD’s)</td>
<td>41%</td>
<td>41%</td>
<td>45%</td>
<td>9%</td>
<td>9%</td>
<td>91%</td>
<td></td>
</tr>
<tr>
<td>Pair and small group activity</td>
<td>53%</td>
<td>53%</td>
<td>47%</td>
<td>9%</td>
<td>9%</td>
<td>94%</td>
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<tr>
<td>Writing tasks</td>
<td>22%</td>
<td>22%</td>
<td>58%</td>
<td>17%</td>
<td>17%</td>
<td>80%</td>
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<td>Graphing software</td>
<td>36%</td>
<td>36%</td>
<td>47%</td>
<td>15%</td>
<td>15%</td>
<td>83%</td>
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<tr>
<td>Other forms of guided inquiry</td>
<td>35%</td>
<td>35%</td>
<td>39%</td>
<td>15%</td>
<td>15%</td>
<td>74%</td>
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<tr>
<td>Support of school administration</td>
<td>24%</td>
<td>24%</td>
<td>34%</td>
<td>7%</td>
<td>7%</td>
<td>58%</td>
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<tr>
<td>Support of technical staff at school</td>
<td>21%</td>
<td>21%</td>
<td>33%</td>
<td>8%</td>
<td>8%</td>
<td>54%</td>
<td></td>
</tr>
<tr>
<td>Digital Video</td>
<td>15%</td>
<td>15%</td>
<td>29%</td>
<td>10%</td>
<td>10%</td>
<td>44%</td>
<td></td>
</tr>
<tr>
<td>Support of teachers at school</td>
<td>10%</td>
<td>10%</td>
<td>32%</td>
<td>16%</td>
<td>16%</td>
<td>42%</td>
<td></td>
</tr>
<tr>
<td>ABP List-Serv</td>
<td>6%</td>
<td>6%</td>
<td>32%</td>
<td>47%</td>
<td>47%</td>
<td>38%</td>
<td></td>
</tr>
</tbody>
</table>
The responses to the items listed above are generally, and in most cases, overwhelmingly positive. Most interesting, perhaps, is the reaction respondents had regarding discussions they had with other teachers during the ABPI workshops. A quarter found these informal interactions to be helpful, and nearly three-quarters found them to be very helpful to their activity-based implementation efforts. Total positive responses are listed on the right-hand side of the bar chart.

"Support of teachers at school" (something clearly beyond the reach of ABPI) was the only category of response that shows a significantly negative bias (32%).

The "Other forms of guided inquiry" which were noted in the free-response portion of the survey as helpful to implementing activity-based approaches in the classroom are listed in Chart 4.2, below.

**Chart 4.2: "Other forms of guided inquiry"**

- AP exam practice.
- *Minds on Physics*.
- PRISMS materials.
- Demonstrations using ILD format of discussion.
- *Modeling Physics*.
- White-boarding problems, predictions individually, and in groups.
- Calculator-based Algebra class.
- Labs written by my colleagues and me that are inquiry-based "discovery" labs.
- CPU and C3P.
- Lillian McDermott's *Tutorials -- Introduction to Physics*: Excellent.
- Modified versions of Vernier's *Physics with Computers*.
- Modeling stuff from ASU.
- I give rather open-ended mini-labs where students must find a result for an observation with minimal guidance from me. It drives them nuts, but I think they like it eventually.
- I had teachers in to observe my classes and have shown teachers ideas during less structured in-service days.
- White-boarding problems, predictions individually, and in groups.
B. Activity Based Physics High School CD

The Activity Based Physics High School CD was developed by ABPI staff and first distributed to Summer 2000 participants at their request, as a means of helping them jump-start implementation of activity-based teaching at participants’ home institutions. The CD has been regularly updated and improved ever since, including, for example, the addition of more and enhanced instructor guidelines.

The following chart lists various elements of the Activity Based Physics High School CD provided to teachers in both cohorts. As before, the list of activities is generally ordered from most helpful to least helpful. (See Appendix III for a complete description of the Activity Based Physics High School CD.)

Chart 4.3: Aids to implementing activity-based teaching in the classroom -- High School CD

“These High School CD modules were helpful in implementing activity-based teaching in my classroom. . . .”

<table>
<thead>
<tr>
<th>Tools for Scientific Thinking (TST)</th>
<th>8% Disagree</th>
<th>43% Mixed Feelings</th>
<th>45% Agree</th>
<th>Total positive response %</th>
</tr>
</thead>
<tbody>
<tr>
<td>RealTime Physics (RT)</td>
<td>11% Disagree</td>
<td>45% Mixed Feelings</td>
<td>42% Agree</td>
<td>87%</td>
</tr>
<tr>
<td>Interactive Lecture Demonstrations (ILD)'s)</td>
<td>9% Disagree</td>
<td>41% Mixed Feelings</td>
<td>50% Agree</td>
<td>91%</td>
</tr>
<tr>
<td>Experiment Files</td>
<td>8% Disagree</td>
<td>54% Mixed Feelings</td>
<td>37% Agree</td>
<td>91%</td>
</tr>
<tr>
<td>Assessment Exams</td>
<td>5% Disagree</td>
<td>11% Mixed Feelings</td>
<td>52% Agree</td>
<td>29%</td>
</tr>
<tr>
<td>Workshop Physics Activity Guide</td>
<td>22% Disagree</td>
<td>55% Mixed Feelings</td>
<td>21% Agree</td>
<td>76%</td>
</tr>
<tr>
<td>Kinematic Worksheets</td>
<td>20% Disagree</td>
<td>53% Mixed Feelings</td>
<td>22% Agree</td>
<td>75%</td>
</tr>
</tbody>
</table>

- The CD gets very high marks as an aid to implementing activity-based teaching approaches to physics. On average, slightly less than half of all respondents agreed that elements of the high school CD were helpful to implementation efforts (46%). In addition, over one-quarter (28% averaging across all seven categories) felt very strongly about the value of these modules. Total positive responses are listed on the right-hand side of the bar chart and run from a low of 75% (Kinematic Worksheets) to a high of 91% (Interactive Lecture Demonstrations and Experiment Files).
C. Two-year workshops

The five charts below illustrate the perceived relative importance of the first year of the workshop vs. the second year to the overall learning achieved. Note: There were no statistically significant differences in how respondents from each cohort (’00-’01; ’02-’03) and each site (Eugene; Carlisle) perceived the relative value of year one vs. year two.

Chart 4.4a – 4.4e: Learning attributable to each year of the two-year workshop cycle

Key: Each scale represents a different “relative value” for each year of the two-year workshop cycle. The pink bar on each scale represents the percentage of ABPI respondents who perceived the value of each respective year of the two-year workshop in a way that corresponds with the reading of the balance in that particular chart.

For example, Chart 4.4b indicates that about 17% of ABPI respondents thought that 60% of all learning attributable to ABPI came after the first year. Chart 4.4d shows that 11% of respondents thought that 60% of their learning came as a result of year two, and so forth.
Overall: It is important to note that regardless of how the data is partitioned, the second year of the workshop was not viewed as redundant. Even those who thought the first year was much more important attributed 30% of their overall learning to the second year (Chart 4.4c). Meanwhile, two-thirds of the respondents (66%) thought the second year was either as important or more important than the first year to the overall learning achieved.

V. ABPI OUTCOMES

A. Changes in allocation of classroom time

The following charts show how respondents allocated time in the classroom. Chart 5.1 shows the amount of class time devoted to group work, class interaction, and lecture, both before (left-hand bars) and after (right-hand bars) participants attended the ABPI workshop. The numbers down the center of the chart indicate the net changes in each of the three categories.

Chart 5.1: Changes in class time usage

As the chart illustrates, physics teachers reported a significant drop in the amount of time devoted to lecture after attending the ABPI workshop (-20%). About a third of this time was reallocated to class interaction (+7%), while the remaining two-thirds of the time cut from traditional lecturing was shifted to time spent doing group work (+13%).

Note: Analysis of the data, while controlling for gender, revealed no statistically significant differences between male and female teachers in the allocation of class time. Gender appears to play little or no role among survey respondents when it comes to predicting how teachers allocated class time, either before or after attending ABPI, among the three categories of classroom activity listed here.
Chart 5.2 shows how the changes in use of class time were actually distributed in each of the three categories.

### Chart 5.2: Distribution of changes in class-time usage

<table>
<thead>
<tr>
<th>Change in amount of class time devoted to</th>
<th>% respondents (n=68)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lecture</td>
<td></td>
</tr>
<tr>
<td>Decrease 10%</td>
<td>16%</td>
</tr>
<tr>
<td>Decrease 20%</td>
<td>34%</td>
</tr>
<tr>
<td>Decrease 30%</td>
<td>43%</td>
</tr>
<tr>
<td>Little change</td>
<td>13%</td>
</tr>
<tr>
<td>Increase 10%</td>
<td>4%</td>
</tr>
<tr>
<td>Increase 20%</td>
<td>24%</td>
</tr>
<tr>
<td>Increase 30%+</td>
<td>12%</td>
</tr>
<tr>
<td>Class interaction</td>
<td></td>
</tr>
<tr>
<td>Decrease 10%</td>
<td>34%</td>
</tr>
<tr>
<td>Decrease 20%</td>
<td>39%</td>
</tr>
<tr>
<td>Decrease 30%</td>
<td>18%</td>
</tr>
<tr>
<td>Increase 10%</td>
<td>18%</td>
</tr>
<tr>
<td>Increase 20%</td>
<td>24%</td>
</tr>
<tr>
<td>Increase 30%+</td>
<td>12%</td>
</tr>
<tr>
<td>Group work</td>
<td></td>
</tr>
<tr>
<td>Decrease 10%</td>
<td>4%</td>
</tr>
<tr>
<td>Decrease 20%</td>
<td>13%</td>
</tr>
<tr>
<td>Decrease 30%</td>
<td>4%</td>
</tr>
<tr>
<td>Increase 10%</td>
<td>18%</td>
</tr>
<tr>
<td>Increase 20%</td>
<td>18%</td>
</tr>
<tr>
<td>Increase 30%+</td>
<td>12%</td>
</tr>
</tbody>
</table>

- **Lecture**: Most participants reported decreases in the amount of class time devoted to lecture of between 10% and 30%. Only 16% reported no change, and no one reported an increase in the amount of class time devoted to lecture after attending ABPI.

- **Class interaction**: Over half of the participants (57%) reported at least some increase in class time devoted to class interaction after attending the workshop. About a third reported no significant changes in time devoted to class interaction. A small number (less than 10%) reported decreasing the amount of time devoted to class interaction.

- **Group work**: The vast majority of participants (79%) reported increasing the amount of time devoted to group work after attending the ABPI workshop. Less than one in five reported no change (18%), and only 3% reported a slight decrease in time devoted to group work.
B. Teaching styles

This set of charts shows what teaching approaches were reported to work best with students, and indicates what methods of data collection respondents used in coming to their conclusions.

Chart 5.3a: Teacher impressions of student reactions to activity-based teaching

- Over half of all students did better using activity-based approaches to teaching physics (56%). Over two-thirds did as well or better with the activity-based approach (69%). Only one in seven (14%) did better with a traditional teaching approach.

- Most instructors used a variety of data gathering approaches to come to the conclusions they did about what teaching approaches worked best with their students, including pre- and post-tests (59%), teaching trends over time (69%), and less formal observations and discussions (79%).
C. Classroom outcomes

This chart indicates teacher perceptions of student reactions to activity-based teaching approaches, including a summary measure of how much more proficient students became as a result of being taught using activity-based methods. The last bar shows much more effective the teachers viewed themselves as a result of using activity-based teaching approaches.

Chart 5.4: Classroom outcomes

Perceived impact of activity-based physics on student learning

<table>
<thead>
<tr>
<th>Strongly Agree</th>
<th>Mixed Feelings</th>
<th>Strongly Disagree</th>
<th>Total positive response %</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>6%</td>
<td>54%</td>
<td>41%</td>
</tr>
</tbody>
</table>

Students were receptive to Activity-Based Physics.

|                | 7%             | 58%               | 33%                      | 91%                      |

Students became more comfortable with Activity-Based Physics over time.

|                | 8%             | 52%               | 41%                      | 93%                      |

Activity-Based Physics helped my students become more proficient

|                | 40%            | 55%               | 5%                       | 95%                      |

Use of Activity-Based Physics has made me a more effective teacher

- The vast majority of students were viewed as receptive to activity-based teaching (first bar: 95%). Moreover, an overwhelming majority of students tended to get more comfortable with the activity-based approach over time (second bar: 91%).
- Participants reported that the vast majority of students became more proficient with class material as a result of activity-based teaching (third bar: 93%).
- The vast majority of respondents viewed their own proficiency as being enhanced by activity-based teaching (last bar: 95%).

Note: Participants reported using activity-based approaches to physics with an average of approximately 100 students per year. Multiplying 100 students (per instructor per year) by 115 instructors suggests that as many as
11,500 students are being taught using activity-based teaching methods each year as a result of the ABPI workshops. (The actual number will be somewhat less than that given attrition due to retirements, reassignments, and career changes made by some ABPI participants.)

In addition to the quantitative data reported in the charts, above, Chart 5.5 reveals three general themes that emerged from free-response section of the survey regarding student outcomes (see responses to question #33 in Appendix II). First, students were reported to have developed a better, richer, and deeper understanding of physical phenomenon. Second, respondents noted that activity-based approaches helped their students make connections between different physical phenomenon, and between physics and the "real world." And third, students were reported to be more excited about, enthusiastic about, and engaged in the course material as a result of activity-based teaching.

<table>
<thead>
<tr>
<th>Chart 5.5: Student learning</th>
<th>n</th>
</tr>
</thead>
<tbody>
<tr>
<td>Students gained a deeper understanding of concepts</td>
<td>22</td>
</tr>
<tr>
<td>Students made more connections within course, and between course concepts and the &quot;real world&quot;</td>
<td>8</td>
</tr>
<tr>
<td>Students were more engaged, had more fun with material</td>
<td>7</td>
</tr>
</tbody>
</table>

D. Implementation

A variety of responses was elicited to the question "What key factors made implementation of ABPI easier?" These responses tended to sort into one of four categories, below. (Some responses are counted in more than one category; see question #26 in Appendix II for the full text of responses from the survey.)

<table>
<thead>
<tr>
<th>Chart 5.6: Key factors to implementation</th>
<th>n</th>
</tr>
</thead>
<tbody>
<tr>
<td>ABPI materials, especially the CD (prepared, flexible materials)</td>
<td>12</td>
</tr>
<tr>
<td>Support of school administrators (including, but not limited to funding support)</td>
<td>11</td>
</tr>
<tr>
<td>Access to funding (internal and external)</td>
<td>8</td>
</tr>
<tr>
<td>Hands-on practice and experience gained during workshops</td>
<td>7</td>
</tr>
</tbody>
</table>

Data on problems with implementation was a bit more focused. Not surprisingly, perhaps, "time" and "money" were the two most commonly cited constraints, here. Some identified equipment issues, as well. If lack of the equipment was the problem being noted, those concerns were logged as "funding" issues, below. (See question #27 in Appendix II for the full text of responses from the survey.)

<table>
<thead>
<tr>
<th>Chart 5.7: Key barriers to implementation</th>
<th>n</th>
</tr>
</thead>
<tbody>
<tr>
<td>Time</td>
<td>19</td>
</tr>
<tr>
<td>Access to funding for equipment and furniture upgrades</td>
<td>18</td>
</tr>
</tbody>
</table>

Later in the survey, respondents were asked to identify key impediments again, with an eye toward formulating remedial strategies. These data are reported in Chart 5.8, below. As with the data reviewed above, "time" and "money" showed up here as the key issues.

<table>
<thead>
<tr>
<th>Chart 5.8: Impediments and recommendations</th>
<th>n</th>
</tr>
</thead>
<tbody>
<tr>
<td>Impediment</td>
<td>Recommendation</td>
</tr>
<tr>
<td>Funding for equipment</td>
<td>Conduct a funding workshop at ABPI</td>
</tr>
<tr>
<td>General lack of time</td>
<td>Make better use of block scheduling</td>
</tr>
<tr>
<td>Time issues related to mandated standards</td>
<td>Align ABP modules with standards; discuss and set priorities to focus on</td>
</tr>
</tbody>
</table>
Regarding money, several respondents suggested that the ABPI team run a module on funding issues in future workshops. Regarding time, block scheduling had some support among respondents as a recommendation. One other issue related to time cropped up here, as well: mandated curriculum. A number of respondents noted (here, and elsewhere in the survey) that time was particularly tight because of a mandated curriculum geared to state learning objectives and end-of-year exams. Some suggested that activity-based teaching modules be aligned with prevailing state standards, while several others suggested that teachers come together to prioritize the most important subjects so that these topics could be focused on more systematically in future workshops. (See question #41 in Appendix II for the full text of responses from the survey.)

E. Funding

This chart depicts the amount of success workshop participants enjoyed with regard to securing funding for their activity-based teaching endeavors. The left side of the chart deals with internal funding requests made to the schools where respondents taught. The right side of the chart deals with external funding requests made to outside granting agencies.

Chart 5.9: Funding

- **Internal funding**: Fifty-four of the 70 survey respondents requested funding from their schools (74%) and all but two of those 54 received at least some support; a success rate of 97%. The average internal grant request was $6,900, and the average grant received was $6,200 (including the two teachers who received no funding at all). Overall, 90% of all internal funds requested were granted ($6,200/$6,900).

- **External funding**: Only three respondents in ten made external requests (21 of 70 respondents; 30%). These teachers enjoyed some significant successes. Thirteen of the 21 requests for external funding were granted (a success rate of 62%). One of these was a large “outlier” request made for a grant of $250,000 (reported to be granted in full). The average grant amount requested by the twelve remaining participants was $9,300, and the average amount granted was $7,000. Overall (and excluding the outlier), 75% of all external funds requested were granted ($7,000/$9,300).

Note: See questions #36 (Internal funding success elaboration) and #38 (external funding success elaboration) in Appendix II for the full-text responses from the survey regarding grant funding.
F. Dissemination

This chart indicates what (if any) methods workshop participants used to disseminate information about activity-based teaching to peers.

Chart 5.10: Dissemination

- A substantial majority of participants report disseminating information about activity-based teaching approaches to peers via conversation and email, and almost half encouraged one or more colleagues to attend a workshop on the subject.
- Overall, participants reported sharing information about activity-based teaching with an average of 12 other physics instructors.
VI. CONCLUSIONS AND RECOMMENDATIONS

There can be little doubt that the ABPI workshops were viewed by participants as extremely successful in achieving the program's stated goals. One has only to view the "final remarks" to get a quick snapshot of the extraordinarily positive feelings teachers had about the experience (see response to question #42 in Appendix II). Respondents do not often take the opportunity to make summary remarks at the end of a lengthy survey such as the one administered for this report. But 45 of 70 respondents (64%) took the time to do so in this case, and 39 of those 45 comments (87%) conveyed glowing comments and words of thanks to those who were involved in making the ABPI workshops a success. This quantity and quality of positive feedback serves as a living testament to the personalities, hard work, and dedication of the ABPI staff.

Several respondents made specific note about the value of the teacher-to-teacher interactions (reinforcement of the first-place ranking of this aspect in Section IV, Chart 4.1). Several other respondents made specific mention of the importance of the second year of the workshop to the overall learning accomplished (also discussed in Section IV, see Charts 4.4a, 4.4b, 4.4c, 4.4d, and 4.4e). Most of the comments expressed pure gratitude to the ABPI leaders at both sites for what many described as the best and most productive professional development experience they had ever had.

This is not to say that there is no room for improvement. The program evaluation of a previous iteration of ABPI (the Dickinson summer seminars on teaching physics using interactive teaching methods and computers cited on page 6 of this report) noted that "time" and "funding" were important issues that could be productively addressed in future workshops (Hoefler, 1998, p. 31). These two issues were once again noted prominently among ABPI participants in results of the survey conducted for this evaluation.

A. Time

In the 1998 report, it was recommended that teaching materials be made more user-friendly and adaptable to different environments and needs. This recommendation was clearly taken to heart in development of ABPI materials. While some commented that it still took too much time to adapt the materials to their own purposes, most respondents lauded the utility of the activity-based materials provided (see Charts 4.1a, 4.1b, and 4.3). With ABPI, concern about "time" tended to be linked with the need to balance use of the activity-based approach with the need to cover specified topics mandated by district-wide curricula and/or state teaching standards. Thus, it seems to be that although the "time crunch" problem remains, the cause has shifted to restrictions imposed from above (as opposed to limitations in the materials themselves).

**Recommendation 1: Orient activity-based physics materials and workshops to standardized curricula.**

The last ten years have been marked by a trend to develop standards and measure outcomes in public education, and physics has not been immune to this development. As a result, high school physics teachers may be more likely to find themselves in a time crunch that comes when what they like to teach using activity-based approaches does not match well with what state and local standards require. Some ABPI modules and some workshop time is devoted to topics that may not appear as priorities in the standards. And some priorities in the standards may not be adequately addressed by the ABPI workshops and materials. Consequently, it may behoove ABPI faculty to do a systematic job of assaying prevailing national, state, and local standards for physics education, and then making a conscious effort to align teaching modules and future workshops to common recurring themes within those standards.

It is beyond the scope of this evaluation to do the kind of analysis that could guide the kind of reorientation that is suggested, here. The project is worth undertaking, though, because the results might help high school physics teachers make better choices about what materials to use when feeling the time crunch created by the need to cover specific topics. Nearly half of all participants from the Dickinson College cohort (48%) came from Pennsylvania (24 participants) or Texas (3 participants), and well over half of the University of Oregon group (61%) came from either Oregon (20 participants), Washington state (9 participants), or Texas (7 participants; see Chart 1.2). Since these four states served as home to a majority of ABPI participants (63 of 115 participants: 55%), these four states might also be a good place to start an assessment of high school standards for physics education so that future workshops (and materials) can be more finely attuned to the curricular environment in which participant-teachers must implement the activity-based teaching approaches being learned. (This assumes that past home state recruitment patterns hold in future workshops, of course.)
At the very least, workshop faculty might consider rank ordering the materials they develop and reorienting workshops slightly so that high school teachers spend workshop time applying their efforts in areas that will be most productive with regard to materials that must be covered, rather than allowing participants to apply themselves in areas of most interest to them. (e.g., when teachers work collaboratively to develop their own modules in the second week). Clearly a balance must be struck here in that it is logical to assume that "teacher interest" is a key component of "buy in" to the activity-based teaching approaches being advanced. It would probably be less than optimally productive to expect teachers to work on modules in the workshops (or adopt materials in their classrooms) which do not "excite" them. At the same time, teachers might be persuaded to use their time and efforts more efficiently if workshop developers put more emphasis on helping teachers find strategic matches between what subjects and concepts interest them and what state and local standards tend to require.

**Recommendation 2: Increase sensitivity to time constraints when developing and modifying ABP materials.**

Quite a few respondents suggested that greater use of block scheduling would help (or has helped) them achieve what they need to accomplish in the classroom, both from a qualitative and a quantitative standpoint. While it is commonly held that activity-based teaching methods are easiest to implement using a block scheduling format (an untested assumption), only about a third of respondents report using this kind of schedule (35%; see Chart 3.4). Meanwhile, nearly half of all respondents report that they operate under the more traditional "standard" form of class scheduling (relatively constrained class periods meeting every day, or most days of the week, throughout the school year). For this reason, it may be necessary to rely more heavily on Interactive Lecture Demonstrations (ILD's) than on apparatus-intensive exercises that can take more time than available to conduct effectively.

It may also be necessary to further streamline other teaching modules and materials so that they are better suited to shorter periods of time. At the least, perhaps modules can be rated on the basis of the amount of time they require to conduct, with rough estimations of set-up and tear-down times required (e.g., general categories such as short, medium, and long might be sufficient). This would not only provide a rough guideline for school teachers, it would also force developers of the materials to keep time constraints in mind as a key priority.

**B. Funding**

Funding required for computers and related apparatus, as well as for furniture, classroom space, and storage space, seems to be as big a constraint on a teacher's ability to implement activity-based teaching approaches as it was in 1998 when the previous evaluation was published. In fact, even though good quality, second-hand computers are often available and despite the fact that prices for some apparatus have actually come down over time, funding continues to be an issue, perhaps because school budgets have faced serious shortages in recent years.
The data collected for this study does give some reason for hope on the funding front. As Chart 5.9 showed, ABPI participants have been relatively successful in attracting funding for their efforts. As noted in Section IV,

- **Internal funding**: Fifty-four of the 70 survey respondents requested funding from their schools (74%) and all but two of those 54 received at least some support; a success rate of 97%. The average internal grant request was $6,900, and the average grant received was $6,200 (including the two teachers who received no funding at all). Overall, 90% of all internal funds requested were granted ($6,200/$6,900).

- **External funding**: Only three respondents in ten made external requests (21 of 70 respondents; 30%). These teachers enjoyed some significant successes. Thirteen of the 21 requests for external funding were granted (a success rate of 62%). One of these was a large "outlier" request made for a grant of $250,000 (reported to be granted in full). The average grant amount requested by the twelve remaining participants was $9,300, and the average amount granted was $7,000. Overall (and excluding the outlier), 75% of all external funds requested were granted ($7,000/$9,300).

Surely some of the internal funding successes can be attributable to the ABPI workshop practice of requiring potential participants to gain "buy in" for support from their local school administrators before being accepted for participation in a workshop. It is also the case that the need for funding has been somewhat relieved by the ABPI faculty who have been extremely entrepreneurial in developing materials which have been provided free to participants (the highly regarded High School CD is a commendable example of the ABPI faculty's efforts in this regard; see Chart 4.3). The High School CD and other materials and support provided to participants have been instrumental in helping teachers kick-start activity based teaching approaches at home. Still, it appears that more needs to be done on the funding front.

**Recommendation 3: Devote more time to grant-writing in future workshops.**

The important role that grant writing can play in a teacher's future success should be highlighted in future workshops. The ABPI faculty are a tremendous source of information in this regard, given the long history of grant-writing and funding successes the principle investigators have achieved, individually and collectively, over the past twenty years. And clearly, some workshop participants have achieved significant successes of their own. Both of these sources of information and support should be tapped in developing a new module on funding in future workshops. In addition:

- A representative of NSF may also be willing to present to the group (whether in person, or at least by teleconference or conference call).

- It may be possible to recruit a member of the grants office from each of the host institutions to provide a pro bono presentation on successful grant-writing.

- It may be useful to invite representatives of PASCO Scientific and Vernier Software & Technology\(^4\) to be part of this process, as well.

- Some participants may be encouraged to develop the beginnings of a grant proposal before they arrive, or during the workshop, so that it can be critiqued by other sets of knowledgeable eyes before the workshop is completed.

Whatever the ABPI faculty do in future workshops to raise the profile of grant writing as a key to success would be helpful. Moreover, the more systematically this issue is addressed, the more positive the downstream outcomes are likely to be.

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4. PASCO and Vernier are the two leading providers of equipment and technology that are central to the implementation of activity based teaching methods in physics.
C. Dissemination

An important component of leadership (noted in Goal 4 of the original grant, see p. 4 of this report) is empowerment. The ability to empower others to lead themselves and their peers is a key measure of leadership success. While the ABPI faculty have demonstrated significant leadership skills in the teaching reform movement, the degree to which those leadership skills have been transferred to workshop participants is somewhat in question. On one hand, as Chart 5.2 (from Section V) illustrates,

A substantial majority of participants report disseminating information about activity-based teaching approaches to peers via conversation and email, and almost half encouraged one or more colleagues to attend a workshop on the subject. Overall, participants reported sharing information about activity-based teaching with an average of 12 other physics instructors.

On the other hand, while the result here is good (in that it appears that some have made efforts to disseminate what they have learned), much of the outcome here seems to have been in the form of casual conversation and email, with only a little over a quarter actually doing more formal outreach and training by presenting workshops (27%). Thus, while there is some dissemination going on, it is also probably the case that the ABPI has not fully capitalized on the potential to "spread the word" using program participants as messengers.

**Recommendation 4: Devote more time to dissemination training in future workshops.**

The ABPI faculty is extremely skilled at presenting activity-based teaching approaches to a variety of audiences in workshop settings. At the same time, the physics education reform movement can not depend solely on direct contact with the principle investigators. Those who attend workshops need to be depended on to do more outreach if activity-based teaching approaches are to reach beyond those who have direct contact with the PI's. While most respondents reported sharing informal conversations and emails with colleagues about activity-based teaching, and nearly half of all respondents encouraged colleagues to attend a workshop, only one in four respondents reported making workshop presentations, themselves. And no respondents reported conducting any significant training activities for colleagues.

Very little if any time is devoted in workshops to shepherding participants along these lines, as presently constituted. The High School CD does contain a “Leadership Packet” with organizational aids for planning and conducting workshops. The CD also contains some background reading and copies of several PowerPoint presentations made by members of the ABPI staff. As useful as these materials are, though, more could be done to smooth the way for already over-burdened high school teachers who would like to share their activity-based physics experiences with others, but who may not be used to or comfortable with making pedagogically-oriented presentations before peers, administrators, or potential funding agencies.

As a supplement to existing materials, then, it is recommended that a CD be developed that includes PowerPoint presentations that introduce the activity-based teaching philosophy (including examples). These presentations should be of varying length and sophistication so that they could be easily tailored to different audiences, venues, and time-frames. Some of the presentations might include embedded links to video clips or other supporting AV files.

Teachers showing potential interest in dissemination activities might be encouraged to make practice presentations with the CD one evening in the second week of the workshop. This experience could give teachers an opportunity to hone their presentation skills and receive constructive criticism in a supportive and friendly environment before taking their "show" out on the road (where audiences may be more skeptical, at least at first).

Participants in the ABPI workshops received a training and development experience that most rank as the best of their professional career. Every effort should be made to capitalize on that experience in future workshops by fostering the notion of "teachers as trainers." Not only will this help create a ripple effect, where workshop participants pass their skills and knowledge on to teachers who did not have the benefit of attending a workshop, the very process of presenting materials to others will likely help the teacher-presenter become more skilled users of the approach, themselves.
The goals, findings, and recommendations of this evaluation, as reported above, are summarized in Chart 6.1, below.

### Chart 6.1: Goals, findings, and recommendations

<table>
<thead>
<tr>
<th>Goals of principle investigators</th>
<th>Findings and recommendations of this evaluation</th>
</tr>
</thead>
</table>
| **Goal 1:** *Develop interactive teaching approaches* using collaborative methods of inquiry which are consistent with national reform efforts. These approaches will help institute participants become active learners, develop confidence in their ability to observe, experiment, analyze, and write about phenomena in physics and physical science, and enjoy the learning process. | **Finding:** Responses to the survey, along with formative evaluation comments, indicate that participants were overwhelmingly satisfied with the approach to learning advanced by the ABPI workshops (see Charts 5.1, 5.2, 5.3a, 5.4, and 5.5 and full-text of responses to question #33 in Appendix II). Not only were institute participants positively affected (see Charts 5.1, 5.2, and 5.4), most reported considerable success in transferring their skills, engagement, confidence, and level of excitement to students in their high school classrooms (see Charts 5.3, 5.4, and 5.5).  
**Recommendation:** Keep up the extraordinary work. |
| **Goal 2:** *Adapt and integrate research-based curricula and teaching methods* into their courses in order to create opportunities for all institute participants to meet local, state, and national standards at the same time evaluate the effectiveness of their curricular changes. | **Finding:** While participants were quite pleased with the training they got and the results they saw in the classroom, the issue of "time" came up again and again as a key constraint. Time was partly an issue because of the pressures felt by teachers to cover district- and state-mandated materials.  
**Recommendation 1:** Orient activity-based physics materials and workshops to standardized curricula.  
**Recommendation 2:** Increase sensitivity to time constraints when developing and modifying ABP materials. |
| **Goal 3:** *Use advanced technology*, including Microcomputer- and Calculator-Based Laboratory (MBL/CBL) tools, Visualizer, spreadsheets, graphing software, and video analysis software to help institute participants develop a firm understanding of the fundamental physics concepts, tackle real world problems, and acquire transferable computer analysis and mathematical modeling skills. | **Finding:** Responses to the survey, along with formative evaluation comments, indicate that participants were overwhelmingly satisfied with the ABPI materials (see Charts 4.1, 4.2, and 4.3) and workshops (see full-text of responses to question #42 in Appendix II).  
At the same time, although it is clear that workshop participants became better able to employ new curricular materials and computer tools more effectively, it also became clear that lack of access to computers and apparatus is serving as a significant impediment for some teachers.  
**Recommendation 3:** Devote more time to grant-writing in future workshops. |
| **Goal 4:** *Provide leadership* in helping other science and mathematics teachers use new curricular material and computer tools more effectively. | **Finding:** While it is clear that the ABPI workshops helped participants achieve considerable success on an individual basis, data on dissemination collected for this report suggest that more could be done to convert program participants into trainers of other teachers.  
**Recommendation 4:** Develop materials and devote more time to dissemination training in future workshops. |
D. Conclusion

Data collected both during and after the ABPI workshops all support the conclusion that the ABPI program was extraordinarily successful. Teacher-participants reported learning valuable teaching skills at the ABPI workshops and reported considerable successes in applying the activity-based approach to teaching physics with an average of over a hundred students each (per year) at their home institutions. Success did not come without extended, intensive work, however: Both the first- and second-year workshops were full of activity (see the workshop schedules in Appendix III), and participants worked hard each day (and many nights) to achieve the proficiency they acquired. Workshop schedules were so intense, in fact, that it may be necessary to do some selective programming triage to make room for sessions on funding (Recommendation 3) and dissemination (Recommendation 4) in any future versions of the ABPI initiative.

The ABPI faculty have refined their approach to these workshops through years of iterations and fine-tuning. While cutting some existing material to make room for new material may be difficult, it may well be worth the effort, given the changing landscape of physics education and the need to find ever more creative ways to build on and disseminate the considerable successes the ABPI faculty have already achieved. Much more serious pruning will have to take place, of course, if a future version of the ABPI workshops shrinks substantially.5

Meanwhile, the principle investigators should be lauded for their accomplishments in the following areas:

- **Workshop feedback.** The ABPI workshop experience received extraordinarily positive marks (see chart 4.1), as did the high school CD the principle investigators developed and distributed to workshop participants (see chart 4.3).

- **Classroom activity.** The ABPI workshops were reported by survey respondents to be responsible for noteworthy shifts in utilization of classroom time. Teachers reported significant cuts in the amount of class time devoted to traditional lectures (from 51% to 31%), while boosting the amount of class time devoted to class interaction by an equivalent amount.

- **Teacher confidence.** Overall, 95% of respondents thought that activity-based approaches made them better teachers.

- **Student performance.** Participants reported that three-quarters of their students did as well or better with the activity-based approach to teaching physics learned via ABPI (see Chart 5.3a). More specifically,
  - 95% of participants reported that their students were generally receptive to activity-based teaching approaches;
  - 91% reported that their student became more receptive to activity-based teaching approaches with time; and,
  - 93% of respondents thought that activity-based teaching helped their students become more proficient with the material (see Chart 5.4).

In sum, few if any programs this reviewer has encountered in over fifteen years of policy analysis and program evaluation have received the breadth and depth of positive feedback that this initiative did. The principle investigators should continue to refine their approach and materials along the lines of the four recommendations noted above. These recommendations deal with relatively minor issues in the larger picture, however. In the end, the strongest and most important finding of this evaluation has to do with the importance of continuing and redoubling the effort to reach high school instructors with the very effective activity-based approach and supporting materials the principle investigators already have in place. The time, energy, talents, and resources the principle investigators have brought to this effort appear to have paid dividends many times over. As such, these efforts seem clearly worthy of continued support.

5. In fact, it is not at all clear that the significant gains achieved via the model used in the ABPI initiative -- two weeks each of two consecutive summers -- could be achieved with a shorter program.
APPENDIX I: Survey Administration
Full text survey as mailed to all participants
Summary "short form" of the survey
Initial contact letter (November 10, 2003)
Follow-up contact letter (December 8, 2003)
   Pasco coupon
   Vernier coupon
Full text survey as mailed to all participants

Activity Based Physics Institute (ABPI)
Survey of Institute Participants
J. Hoefer – Draft 3 – 10.21.03

Teacher Background

1. Year. In what year(s) and location(s) did you attend the ABPI?
   - 2000: Oregon: , Dickinson: 
   - 2001: Oregon: , Dickinson: 
   - 2002: Oregon: , Dickinson: 
   - 2003: Oregon: , Dickinson: 

2. Teacher Gender.  ○ male  ○ female

3. Teaching experience. How many years of experience do you have teaching physics?

4. Teaching age. How old are you now?

5. Degree. What level of college education do you have? (check all applicable)
   ○ B.S.  ○ Some graduate work  ○ Masters  ○ Some Ph.D. work  ○ Ph.D.

6. Major. What was your major in college?

<table>
<thead>
<tr>
<th>Undergrad. Major</th>
<th>Physics</th>
<th>Physics Education</th>
<th>Bio or Chem</th>
<th>Math or Engineer.</th>
<th>other science</th>
<th>other</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minor (if applicable)</td>
<td>Physics</td>
<td>Physics Education</td>
<td>Bio or Chem.</td>
<td>Math or Engineer.</td>
<td>other science</td>
<td>other</td>
</tr>
<tr>
<td>Graduate (if applicable)</td>
<td>Physics</td>
<td>Physics Education</td>
<td>Bio or Chem.</td>
<td>Math or Engineer.</td>
<td>other science</td>
<td>other</td>
</tr>
</tbody>
</table>

7. Specialization. Which category best describes your training and experience?
   ○ Specialist (physics degree and physics teaching experience)
   ○ Career (no physics degree but extensive physics teaching experience)
   ○ Occasional (no physics degree and little physics teaching experience)

8. Assignment. What role does physics play in your current or most recent teaching assignment?
   ○ I teach only physics (or physical science).
   ○ I teach mostly physics (or physical science).
   ○ My teaching is split about equally between physics and non-physics courses.
   ○ I mostly teach non-physics courses.
9. **News.** How did you hear about the ABPI workshops? (check as many as apply)

- direct mail
- word of mouth
- web page
- NSTA Reports
- list-serve
- Physics Teacher
- Science Teacher
- Regional or statewide science conference
- Other . . . Please specify:

**School Background** (current or most recent)

10. **School type:**  
- Public
- Private Secular
- Mainstream Religious
- Fundamentalist

11. **Size.** About how many seniors are there at your school this year?  

12. **School Demographics.** About what % of students in your school are minority?  

13. **Class Demographics.** About what % of students in your physics classes are minority?  

14. **Student Gender.** About what % of students in your physics classes are female?  

15. **Income.** About what % of your student body qualifies for the federal school breakfast program?  
- under 20%
- 20-40%
- 40-60%
- over 60%

16. **Setting.** Which characterization comes closest to describing the setting of your school?  
- rural
- Small city or large town (Carlisle)
- Smaller metro area (Eugene)
- Suburbs of a larger metro area
- Central city of a large metro area

**Teaching** (current or most recent)

17. **Classes.** What courses do you typically teach in what grade levels? (check all applicable)

<table>
<thead>
<tr>
<th>Conceptual Physics for:</th>
<th>7th</th>
<th>8th</th>
<th>9th</th>
<th>10th</th>
<th>11th</th>
<th>12th</th>
</tr>
</thead>
<tbody>
<tr>
<td>Regular 1st-year Physics for:</td>
<td>7th</td>
<td>8th</td>
<td>9th</td>
<td>10th</td>
<td>11th</td>
<td>12th</td>
</tr>
<tr>
<td>Honors Physics for:</td>
<td>7th</td>
<td>8th</td>
<td>9th</td>
<td>10th</td>
<td>11th</td>
<td>12th</td>
</tr>
<tr>
<td>AP Physics for:</td>
<td>7th</td>
<td>8th</td>
<td>9th</td>
<td>10th</td>
<td>11th</td>
<td>12th</td>
</tr>
<tr>
<td>Chemistry for:</td>
<td>7th</td>
<td>8th</td>
<td>9th</td>
<td>10th</td>
<td>11th</td>
<td>12th</td>
</tr>
<tr>
<td>Other physical science for:</td>
<td>7th</td>
<td>8th</td>
<td>9th</td>
<td>10th</td>
<td>11th</td>
<td>12th</td>
</tr>
<tr>
<td>Mathematics for:</td>
<td>7th</td>
<td>8th</td>
<td>9th</td>
<td>10th</td>
<td>11th</td>
<td>12th</td>
</tr>
</tbody>
</table>
18. Class Sizes. What are the sizes of the classes you typically teach?

| Smallest class | ○ <10 | ○ 10-15 | ○ 16-20 | ○ 21-25 | ○ 26-30 | ○ 30+ |
| Largest class  | ○ <10 | ○ 10-15 | ○ 16-20 | ○ 21-25 | ○ 26-30 | ○ 30+ |
| Typical class  | ○ <10 | ○ 10-15 | ○ 16-20 | ○ 21-25 | ○ 26-30 | ○ 30+ |

19. Contact time. How long do your classes typically meet, and how often?

- ○ Block scheduling
- ○ Standard-length
- ○ Variable-length periods
- ○ Other schedule

20. Peers. How many colleagues do you have daily contact with at your school?

- Other physics teachers
- ○ none  ○ 1  ○ 2  ○ 3  ○ 4 +
- Other Science/Math teachers
- ○ none  ○ 1  ○ 2  ○ 3  ○ 4 +

21. Peers. Total number of colleagues at your school who are interested in activity-based teaching?

- ○ none  ○ 1  ○ 2  ○ 3  ○ 4 +

Effectiveness

22. Impact. "Attending the Activity Based Physics Institute has made me a more effective teacher."

- ○ strongly agree  ○ agree  ○ mixed feelings  ○ disagree  ○ strongly disagree

23. Year effects. The following scale represents the total benefit you received from attending both 2-week ABPI workshops. Please draw a line to indicate the relative benefits of attending the first year vs. the second year. For example, if each year was equally worthwhile, draw a line at the "50%" mark.

<table>
<thead>
<tr>
<th>% benefits attributed to the 1st year</th>
<th>% benefits attributed to the 2nd year</th>
</tr>
</thead>
<tbody>
<tr>
<td>10%</td>
<td>20%</td>
</tr>
</tbody>
</table>

24. Class time. How has the % of class time you devote to the following activities changed?

- Lecture (e.g., formal lecture, one-way explanations of procedures, etc.)
  - Before ABPI
  - After ABPI
- Instructor-student interaction (e.g., discussing predictions + results, etc.)
  - Before ABPI
  - After ABPI
- Student-centered activity (e.g., developing predictions, hands-on experiments, etc.)
  - Before ABPI
  - After ABPI

| 100 % | 100 % |
### 25. Activities

"These activities, materials, and other factors were key in helping me enhance physics instruction for my students."

<table>
<thead>
<tr>
<th>Activity</th>
<th>strongly agree</th>
<th>agree</th>
<th>mixed feelings</th>
<th>disagree</th>
<th>strongly disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pair or small group discussion</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Whole-class discussion or interactive demos</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Writing tasks (e.g., prediction)</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Interactive lecture demonstrations</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Use of interfacing (e.g., MBL, CBL)</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Digital video analysis</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Graphing software; graphic calculator</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td><strong>Tools for Scientific Thinking</strong></td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td><strong>RealTime Physics</strong></td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td><strong>Workshop Physics Activity Guide</strong></td>
<td>○</td>
<td>○</td>
<td>○</td>
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<td>○</td>
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<tr>
<td><strong>ILDs</strong></td>
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<tr>
<td>Kinematics Worksheets</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Nuclear radiation</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>The New Mechanics</td>
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<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>UMD Sound</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
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</tr>
<tr>
<td>Experiment files</td>
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<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Assessment exams</td>
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<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Other commercially published ABP materials</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Discussions with others during ABPI residency</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>ABPI list-serve</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Support of other teachers in my own school</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Support of school administrators</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Support staff (e.g., tech. support personnel)</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Other forms of “guided inquiry” (list)</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
</tbody>
</table>

**Other forms of “guided inquiry” activities used (optional):**
26. Ease factors. If there were key factors that make your implementation of ABPI principles easier
to implement than it might be otherwise, please take a moment to describe them here.

Other "ease" factors (optional):

27. Hard factors. If there were key factors that make your implementation of ABPI principles
harder to implement than it might be otherwise, please take a moment to describe them here:

Other "hard" factors (optional):

28. Receptiveness. "Most students were open to a more activity-based approach to learning."
   ○ strongly agree ○ agree ○ mixed feelings ○ disagree ○ strongly disagree

29. Comfort level. "Students became more comfortable with activity-based physics over time."
   ○ strongly agree ○ agree ○ mixed feelings ○ disagree ○ strongly disagree

30. Proficiency. "Activity-based approaches helped my students become more proficient in their
understanding of physics."
   ○ strongly agree ○ agree ○ mixed feelings ○ disagree ○ strongly disagree

31. Improvements. How does student understanding of course material taught using a "traditional"
lecture-based approach compare with student understanding using at least some activity-based teaching
methods?

<table>
<thead>
<tr>
<th></th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>This % of students see to do better with the activity-based approach.</td>
<td>%</td>
</tr>
<tr>
<td>This % of students do better with a &quot;traditional&quot; lecture-based approach.</td>
<td>%</td>
</tr>
<tr>
<td>This % of students seem unaffected by the teaching approach.</td>
<td>%</td>
</tr>
<tr>
<td>I am not sure how the use of activity-based approaches has affected this group.</td>
<td>%</td>
</tr>
<tr>
<td>100 %</td>
<td></td>
</tr>
</tbody>
</table>

32. Assessment: How did you arrive at your assessment of student understanding (choose as many
as apply)?
   ○ Pre- and post-testing with particular
classes on particular topics ○ Testing trends
   over time ○ Informal discussions
   and observations
33. Learning elaboration. Could you comment on the "nature" of the learning students experience using activity-based approaches, versus the nature of the learning using more traditional approaches?

Nature of learning (optional):

34. ABPI-exposed students. Roughly speaking, about how many students have you taught using at least some ABPI approaches over the years? students

Other issues

35. Internal request. What amount of financial support (if any) have you requested from your school to help implement ABPI approaches in your teaching? $

36. Internal success. What amount of internal financial support (if any) has materialized?

Elaboration (optional):

37. External request. What amount of financial support (if any) have you requested in the form of grants from outside agencies and organizations? $

38. External success. What amount of external financial support (if any) has materialized?

Elaboration (optional):

39. Dissemination. Have you related your experiences with the ABPI approach to other teachers of physics? (Choose as many as apply.)

- Yes, through informal conversations or e-mail with colleagues.
- Yes, by encouraging one or more colleagues to attend a workshop.
- Yes, by speaking at workshops. How many?
- Other means. Please specify:
- No, I have not.

40. Promulgation. Approximately how many other physics teachers (not counting ABPI colleagues) have you talked to or communicated with about activity-based physics?
**41. Impediments.** What impediments to fully implementing activity-based physics do you face? What could be done (in future workshops or otherwise) to help you overcome this particular impediment?

<table>
<thead>
<tr>
<th>Impediment 1:</th>
<th>Recommendation 1:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Impediment 2:</td>
<td>Recommendation 2:</td>
</tr>
<tr>
<td>----------------------------------</td>
<td>-------------------</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Impediment 3:</td>
<td>Recommendation 3:</td>
</tr>
<tr>
<td>----------------------------------</td>
<td>-------------------</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**42. Final remarks.** If there is anything else you would like to comment on, I would appreciate hearing your thoughts so that they might be incorporated into my final report.

Summary remarks (optional):

---

You can mail this survey back to me in the enclosed, postage-paid envelop. If you have misplaced the envelop, my address is:

Jim Hoefler  
Department of Political Science  
Dickinson College  
Carlisle, PA 17013
Summary "short form" of the survey

Teacher Background

1. Year. In what year(s) and location(s) did you attend the ABPI?
   [2000-2001 | 2002-2003] [Eugene | Carlisle]

2. Teacher Gender. [male | female]

3. Teaching experience. How many years of experience do you have teaching physics? [fill in blank]

4. Teaching age. How old are you now? [fill in blank]

5. Degree. What level of college education do you have?
   • B.S.
   • Some graduate work
   • Masters
   • Some Ph.D. work
   • Ph.D.

6. Major. What was your major in college? (also minor [if applicable] and graduate work [if applicable].)
   • Physics
   • Physics Education
   • Biology or Chemistry
   • Math or Engineering
   • Other science
   • Other

7. Specialization. Which category best describes your training and experience?
   • Specialist (physics degree and physics teaching experience)
   • Career (no physics degree but extensive physics teaching experience)
   • Occasional (no physics degree and little physics teaching experience)

8. Assignment. What role does physics play in your current or most recent teaching assignment?
   • I teach only physics (or physical science).
   • I teach mostly physics (or physical science).
   • My teaching is split about equally between physics and non-physics courses.
   • I mostly teach non-physics courses.

9. News. How did you hear about the ABPI workshops?
   • Direct mail
   • Word of mouth
   • Web page
   • NSTA Reports
   • List-serve
   • Physics Teacher
   • Science Teacher
   • Regional or statewide science conference
   • Other

School Background (current or most recent)

10. School type
    • Public
    • Private Secular
• Mainstream Religious
• Fundamentalist

11. Size. About how many seniors are there at your school this year? [fill in blank]

12. School Demographics. About what % of students in your school are minority? [fill in blank]

13. Class Demographics. About what % of students in your physics classes are minority? [fill in blank]

14. Student Gender. About what % of students in your physics classes are female? [fill in blank]

15. Income. About what % of your student body qualifies for the federal school breakfast program?  
[under 20% | 20-40% | 40-60% | over 60%]

16. Setting. Which characterization comes closest to describing the setting of your school?
• Rural
• Small city or large town (Carlisle)
• Smaller metro area (Eugene)
• Suburbs of a larger metro area
• Central city of a large metro area

Teaching (current or most recent)

17. Classes. What courses do you typically teach in what grade levels? (check all applicable)
• Conceptual Physics
• Regular 1st-year Physics
• Honors Physics
• AP Physics
• Chemistry
• Other physical science
• Mathematics

18. Class Sizes. What are the sizes of the classes you typically teach?
• Smallest class
• Largest class
• Typical class

19. Contact time. How long do your classes typically meet, and how often?
• Block scheduling
• Standard-length periods
• Variable-length periods
• Other schedule

20. Peers. How many colleagues do you have daily contact with at your school?
• Other physics teachers [none | 1 | 2 | 3 | 4+]
• Other Science/Math teachers [none | 1 | 2 | 3 | 4+]

21. Peers. Total number of colleagues at your school who are interested in activity-based teaching?  
[none | 1 | 2 | 3 | 4+]

Effectiveness

22. Impact. "Attending the Activity Based Physics Institute has made me a more effective teacher."  
[strongly agree | agree | mixed feelings | disagree | strongly disagree]
23. **Year effects.** The following scale represents the total benefit you received from attending both 2-week ABPI workshops. Please draw a line to indicate the relative benefits of attending the first year vs. the second year. For example, if each year was equally worthwhile, draw a line at the “50%” mark. [fill in blank]

24. **Class time.** How has the % of class time you devote to the following activities changed (before and after ABPI)?
   - Lecture (e.g., formal lecture, one-way explanations of procedures, etc.)
   - Instructor-student interaction (e.g., discussing predictions + results, etc.)
   - Student-centered activity (e.g., developing predictions, hands-on experiments, etc.)

25. **Activities.** "These activities, materials, and other factors were key in helping me enhance physics instruction for my students." [strongly agree | agree | mixed feelings | disagree | strongly disagree]
   - Whole-class discussion or interactive demos
   - Writing tasks (e.g., prediction)
   - Interactive lecture demonstrations
   - Use of interfacing (e.g., MBL, CBL)
   - Digital video analysis
   - Graphing software; graphic calculator
   - High School CD: Tools for Scientific Thinking
   - High School CD: RealTime Physics
   - High School CD: Workshop Physics Activity Guide
   - High School CD: ILD's
   - High School CD: Kinematics Worksheets
   - High School CD: Nuclear radiation
   - High School CD: The New Mechanics
   - High School CD: UMD Sound
   - High School CD: Experiment files
   - High School CD: Assessment exams
   - Other commercially published ABP materials
   - Discussions with others during ABPI residency
   - ABPI list-serve
   - Support of other teachers in my own school
   - Support of school administrators
   - Support staff (e.g., tech. support personnel)
   - Other forms of "guided inquiry" (list)

26. **Ease factors.** If there were key factors that make your implementation of ABPI principles easier to implement than it might be otherwise, please take a moment to describe them here. [open-ended]

27. **Hard factors.** If there were key factors that make your implementation of ABPI principles harder to implement than it might be otherwise, please take a moment to describe them here. [open-ended]

28. **Receptiveness.** "Most students were open to a more activity-based approach to learning."
   [strongly agree | agree | mixed feelings | disagree | strongly disagree]

29. **Comfort level.** "Students became more comfortable with activity-based physics over time."
   [strongly agree | agree | mixed feelings | disagree | strongly disagree]

30. **Proficiency.** "Activity-based approaches helped my students become more proficient in their understanding of physics." [strongly agree | agree | mixed feelings | disagree | strongly disagree]

31. **Improvements.** How does student understanding of course material taught using a "traditional" lecture-based approach compare with student understanding using at least some activity-based teaching methods?
   - This % of students seem to do better with the activity-based approach. [fill in blank]
   - This % of students do better with a "traditional" lecture-based approach. [fill in blank]
   - This % of students seem unaffected by the teaching approach. [fill in blank]
   - I am not sure how the use of activity-based approaches has affected this group. [fill in blank]

32. **Assessment:** How did you arrive at your assessment of student understanding (choose as many as apply)?
- Pre- and post-testing with particular classes on particular topics
- Testing trends over time
- Informal discussions and observations

33. Learning elaboration. Could you comment on the "nature" of the learning students experience using activity-based approaches, versus the nature of the learning using more traditional approaches? [open-ended]

34. ABPI-exposed students. Roughly speaking, about how many students have you taught using at least some ABPI approaches over the years? [fill in blank]

Other Issues

35. Internal request. What amount of financial support (if any) have you requested from your school to help implement ABPI approaches in your teaching? [fill in blank]

36. Internal success. What amount of internal financial support (if any) has materialized? [fill in blank]

37. External request. What amount of financial support (if any) have you requested in the form of grants from outside agencies and organizations? [fill in blank]

38. External success. What amount of external financial support (if any) has materialized? [fill in blank]

39. Dissemination. Have you related your experiences with the ABPI approach to other teachers of physics? (Choose as many as apply.)
   - Yes, through informal conversations or e-mail with colleagues.
   - Yes, by encouraging one or more colleagues to attend a workshop.
   - Yes, by speaking at workshops.
   - Other means. (Please specify)
   - No, I have not.

40. Promulgation. Approximately how many other physics teachers (not counting ABPI colleagues) have you talked to or communicated with about activity based physics? [fill in blank]

41. Impediments. What impediments to fully implementing activity-based physics do you face? What could be done (in future workshops or otherwise) to help you overcome this particular impediment? [open-ended]

42. Final remarks. If there is anything else you would like to comment on, I would appreciate hearing your thoughts so that they might be incorporated into my final report. [open-ended]
November 10, 2003

Dear Colleague:

My name is Jim Hoefler. I am a professor of political science at Dickinson College and have been contracted by the Activity Based Physics Institute (ABPI) team to conduct an evaluation of the ABPI program. (I had the pleasure of meeting you, if you were at the summer '03 workshop held at Dickinson.)

The enclosed survey will serve as the data collection instrument for the evaluation, and your thoughts and opinions are the key to the success of this project. I apologize in advance for imposing on you, but ask that you take a few minutes to fill out this survey and return it to me by December 1, 2003. You can mail it back to me in the enclosed envelope. No postage is required--just drop it in the mail. I ask for no names, and all response data will be kept in strict confidence.

As a small token of my appreciation, I am including $20 gift certificates from both PASCO Scientific and Vernier Software & Technology. Have fun with what you buy!

Also, I will be happy to make my findings available to you after they have been compiled and analyzed. I expect to be able to provide you with a summary report some time in mid-spring, 2004.

Once again--your thoughts and opinions are key to the success of this evaluation project. Thanks so much for taking the time to contribute to our knowledge base about activity-based physics!

Very sincerely,

Jim Hoefler, Ph.D.
Department of Political Science
Dickinson College
Carlisle, PA 17013

(717) 245-1311

Enclosures
December 8, 2003

Dear Colleague:

Jim Hoefler here, again, with two purposes in mind. First, I need to send a hearty THANK YOU! to the 45 of you who completed and returned the Activity Based Physics Institute (ABPI) survey I sent out on November 8th.

Second, for those who have not had a chance to get to it, please do take a few minutes to complete the survey and send it back in the postage paid envelop previously provided. If the materials got lost or never got to you in the first place, don't hesitate to call or email and we will get a new packet out to you the same day. We really do need your input to generate a set of valid and reliable results that could lead to more and improved programming down the road.

Once again, thanks to those who have returned their surveys. And for those who have not -- we are counting on you to come through by January 1, 2004.

Very best wishes to you all for a happy, healthy, and peaceful holiday season.

Sincerely,

Jim Hoefler, Ph.D.
Department of Political Science
Dickinson College
Carlisle, PA 17013
(717) 245-1311
hoefler@dickinson.edu
Discount Certificate

This entitles __________________
from ______________________ High School who attended
the Activity Based Physics Institute during the summers of
_________ to a $20 discount toward the purchase of any
PASCO scientific equipment or software.

To redeem this certificate, simply enclose it with an order before

Mail to:
PASCO scientific
10101 Foothills Blvd
Roseville CA 95747
APPENDIX II: Survey Responses
Respondent profiles
Responses to open-ended questions
### Chart II.1: Respondent profiles

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**Key to “orientation”**
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- Career (no physics degree but extensive physics teaching experience)
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Key to "orientation"  
Specialist (physics degree and physics teaching experience)  
Career (no physics degree but extensive physics teaching experience)  
Occasional (no physics degree and little physics teaching experience)
Responses to open-ended questions

9. News (open-ended responses). How did you hear about the ABPI workshops?

Respondent 2: Vernier newsletter
Respondent 3: Email from District Coordinating Teacher
Respondent 7: Vernier newsletter
Respondent 14: Math/Science bulletin
Respondent 17: Announcer, AAPT
Respondent 28: AAPT Summer conference
Respondent 30: Southern CA AAPT
Respondent 35: Vernier newsletter
Respondent 41: Vernier website
Respondent 45: NSTA/PSTA conference
Respondent 46: Math and Science course bulletin
Respondent 61: Vernier Newsletter
Respondent 65: Coordinator

25. Activities. "These activities, materials, and other factors were key in helping me enhance physics instruction for my students." [Other forms of "guided inquiry"]

Respondent 12: CPU and C3P.
Respondent 21: AP exam practice.
Respondent 30: Demonstrations using ILD format of discussion.
Respondent 32: Modeling Physics.
Respondent 41: White-boarding problems, predictions individually, and in groups.
Respondent 42: Calculator-based Algebra class.
Respondent 43: Labs written by my colleagues and me that are inquiry-based "discovery" labs.
Respondent 56: Modified versions of Vernier's Physics with Computers.
Respondent 60: Modeling stuff from ASU.
Respondent 62: I give rather open-ended mini-labs where students must find a result for an observation with minimal guidance from me. It drives them nuts, but I think they like it eventually.
Respondent 63: I had teachers in to observe my classes and have shown teachers ideas during less structured in-service days.

26. Ease factors. If there were key factors that make your implementation of ABPI principles easier to implement than it might be otherwise, please take a moment to describe them here.

Ease Factors Analysis. Though variety of responses was elicited to this question, they tended to sort into one of four categories, below (some responses are counted in more than one category).
<table>
<thead>
<tr>
<th>Key factors to implementation</th>
<th>n</th>
<th>respondents</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hands-on practice and experience gained during workshops</td>
<td>7</td>
<td>2, 16, 24, 35, 37, 41, 63</td>
</tr>
<tr>
<td>Access to funding</td>
<td>8</td>
<td>5, 17, 19, 25, 30, 39, 47, 68</td>
</tr>
<tr>
<td>Support of school administrators (including, but not limited to funding support)</td>
<td>11</td>
<td>9, 14, 17, 22, 25, 30, 39, 43, 56, 60, 67</td>
</tr>
<tr>
<td>ABPI materials, especially the CD (prepared, flexible materials)</td>
<td>12</td>
<td>10, 12, 13, 16, 24, 27, 33, 34, 40, 54, 55, 61</td>
</tr>
</tbody>
</table>

**Respondent 2:** Practicing the ILD's as part of the workshop.

**Respondent 3:** Another teacher in my building had written a grant to obtain probe-ware so I already had much of the equipment I would need.

**Respondent 4:** Being really good friends with the tech coordinator.

**Respondent 5:** I received a Gates Technology grant, therefore I had 8 computers.

**Respondent 7:** It's difficult for me to load the activities on the lab computer because of the district rules regarding installing software. So I have to manually change each computer and save to desktop.

**Respondent 9:** The agreement that administrators had to make to supply classroom with hardware.

**Respondent 10:** Having electronic version of the materials (on CD) made it easy to use and modify materials to make them better fit my needs.

**Respondent 12:** Able to adjust word files to suit your needs.

**Respondent 13:** Materials were ready to use -- my predecessor gave me a lot of help.

**Respondent 14:** Admin support I had for improving physics instruction.

**Respondent 16:** High school CD, having done the experiments ourselves during the institute.

**Respondent 17:** Support of school to obtain and support technology.

**Respondent 19:** Funding grant for equipment purchase.

**Respondent 21:** Support from Priscilla and others.

**Respondent 22:** Support of administration.

**Respondent 23:** List serve, opportunity for follow-up support.

**Respondent 24:** Large amounts of examples' practice writing; and applying techniques and strategies.

**Respondent 25:** Financial and equipment support of my school.

**Respondent 27:** Materials easy to use.

**Respondent 28:** My personal interest in using technology in my physics teaching.

**Respondent 29:** Vernier software ease with sensor.

**Respondent 29:** Existing textbook, format and structure.

**Respondent 30:** Money available on demand; computer donations.

**Respondent 33:** Graphing of motion made easier by ABPI activities.
Respondent 34: Activities that are pre-tested and learned they are affective.

Respondent 35: All of the hands-on experience we received at Dickinson was critical for me. I was pretty confident with force and motion labs, and ILD’s.

Respondent 37: There is a huge learning curve in learning the probe software -- that's what made year 2 so good. We smoothed out a lot of problems. You don't even know what questions to ask until you run into problems with students.

Respondent 39: Administrative support and funding.

Respondent 40: Having experiment and video files all in one place.

Respondent 41: The institute experience gave me confidence and practice time using materials.

Respondent 42: Having someone to email and ask questions after trying it myself.

Respondent 43: The support from the science department chair has been key to the success of implementation!

Respondent 44: Some of my students help me troubleshoot the equipment set-up.

Respondent 45: Willingness to try a different approach and having used Data Studio prior to ABPI.

Respondent 47: Access to equipment. $ is hard to find! The size of my physics class DOUBLED and now I don't have enough for easy logistics and good sized lab groups.

Respondent 54: Logger Pro experiment files.

Respondent 55: Electronic documents of ABPI materials on CD that can be edited to suit my needs: BIG TIME SAVER!

Respondent 56: Strong support from science department chair and principal.

Respondent 58: More time during school day for "teacher work" vs. 7/8 teaching and duty.

Respondent 60: Principal's support.

Respondent 61: Having a CD with materials is very helpful.

Respondent 62: Motion detectors that worked consistently, i.e., only measured the object you want.

Respondent 63: Having time to "play" with the equipment and activities and to discuss them with colleagues during the workshop.

Respondent 64: We have had access to computers (Macs), probes, and sensors (Vernier), which have made implementation of ABPI principles easier.

Respondent 65: Southwestern Medical School donated computers and my school purchased some. I like using computers over calculators.

Respondent 66: Range of ideas was nice but some second year (modules?) need more development to be like mechanics.

Respondent 67: My district bought me a great start with equipment (involved in creating ease).

Respondent 68: Grant $ to buy equipment.

Respondent 69: Attending the workshops with another teacher from my school was extremely beneficial.
27. **Hard factors.** If there were key factors that make your implementation of ABPI principles harder to implement than it might be otherwise, please take a moment to describe them here.

**Hard Factors Analysis:** Not surprisingly, perhaps, "time" and "money" were the two most commonly cited constraints, here. Some identified equipment issues as well. If getting the equipment was the problem, those concerns are logged as "money" issues, below.

<table>
<thead>
<tr>
<th>Key barriers to implementation</th>
<th>n</th>
<th>respondents</th>
</tr>
</thead>
<tbody>
<tr>
<td>Time</td>
<td>19</td>
<td>1, 3, 6, 13, 15, 17, 20, 24, 26, 34, 38, 39, 44, 45, 47, 53, 55, 58, 66</td>
</tr>
<tr>
<td>Access to funding for equipment and furniture upgrades</td>
<td>18</td>
<td>5, 7, 14, 15, 21, 25, 27, 28, 32, 33, 36, 40, 41-43, 51, 57, 64</td>
</tr>
</tbody>
</table>

**Respondent 1:** Materials arrived late in year (not ABPI's fault). Time became a problem I had not anticipated.

**Respondent 2:** Inconsistent functionality of some of the sensors.

**Respondent 3:** Time -- like everything in teaching, time is always a factor. Time to plan, time to implement in class and still get through the district/state mandated curriculum.

**Respondent 4:** Quality of computers.

**Respondent 5:** Getting money for lab pro's and updated sensors.

**Respondent 6:** Time for preparation (computers and equipment).

**Respondent 7:** Space in my lab, extra pieces of equipment, no camera yet or video analysis.

**Respondent 9:** The High School CD is difficult to use, specifically if one wants to edit activities.

**Respondent 12:** Lack of experience -- gets better every year.

**Respondent 13:** Time adapting to existing curriculum.

**Respondent 14:** Equipment cost.

**Respondent 15:** More time and more money for more equipment.

**Respondent 16:** Using Vernier equipment at the institute when I had Pasco equipment [at home].

**Respondent 17:** Time!! It is really hard to find time to be creative and develop ideas off of key principles and to find time to collaborate and reflect.

**Respondent 19:** Funding grant for equipment purchase.

**Respondent 20:** Time to develop new ILD's in all areas (Chem., AP Chem., Physical Science).

**Respondent 21:** Older computers.

**Respondent 22:** Learning how to use technology.

**Respondent 23:** List serve, opportunity for follow-up support.

**Respondent 24:** It took some time to convince the school district that the High School CD would not cause problems with out network.
Respondent 25: Financial and equipment support of my school.

Respondent 26: Time -- with a regular schedule, continuity is missed.

Respondent 27: Lack of funds for hardware.

Respondent 28: Limitations due to equipment and funding.

Respondent 29: Existing textbook, format and structure.

Respondent 30: Wording too difficult for my students.

Respondent 32: Money; new furniture to provide more flexibility.

Respondent 33: School district not willing to spend money on equipment.

Respondent 34: Amount of material I am required to teach in year.

Respondent 35: Tech support at my school is not very good. We have one tech guy for four buildings. It's tough to get help.


Respondent 37: Digital video analysis: I needed more training with MY equipment. Introduce it year 1 and let us bring our laptops and cameras to help us get everything working together with VideoPoint.

Respondent 38: Not enough planning time to test CBL's. Not having a classroom of my own.

Respondent 39: Planning time and trouble-shooting time were in large demand with CBL.

Respondent 40: The materials are all formatted differently making it difficult to mix and match what works in your environment. Specialty equipment.

Respondent 41: Cost is an issue for me. Also time to set up and break down can be difficult in my setting.

Respondent 42: No budget and very little equipment, and very old computer (I am writing grants).

Respondent 43: Budget constraints and technology budget cuts have limited the scope of implementation. Computer hardware is in need of updating.

Respondent 44: I think the lack of understanding on the part of my administration and my doing it alone has not been positive. The time it takes to run a lab is a drain, as well.

Respondent 45: Time to cover content and to meet state standards. To use ABPI requires time.

Respondent 47: Lots of good practice time in the workshop.

Respondent 48: No lab room; only two computers; limited storage space.

Respondent 49: Students found the process too slow.

Respondent 51: Obtaining equipment: Sensors, interfaces, computers, and software.

Respondent 53: Only having physical science as a 1-semester course. I feel I could do SO much more with 2 semesters.

Respondent 54: Paper consumption.

Respondent 55: Time involved (class time) -- Interactive strategies take more time.
Respondent 56: Adopting published activity-based inquiries to suit all-girl physics classes with little previous experience and weak math skills. Implementation is taking close to 3-4 years or perhaps 5.

Respondent 57: Not enough tech equipment; cost of equipment; slow computers.

Respondent 58: Time issues are biggest factor.

Respondent 60: Too much to teach and students are from Asia and are hesitant to speak in class and all they know is "lecture style."

Respondent 61: I wish I had another physics teacher to discuss things with.

Respondent 62: The high learning curve on using the data collection equipment.

Respondent 63: Getting the CD so late in the school year.

Respondent 64: Computers are older models (Mac 5200 series) and this has inhibited data collection in certain areas such as waves, sound, and light.

Respondent 65: Southwestern Medical School donated computers and my school purchased some. I like using computers over calculators.

Respondent 66: Time to revisit and implement in class.

Respondent 67: End of semester tests -- district-wide tests are poorly written and require regurgitation of facts rather than understanding of concepts.

Respondent 68: Hard to keep small groups of students working -- lots of ADHD.

Respondent 69: Setting up and using equipment was difficult -- more practice helps.

33. Learning elaboration. Could you comment on the "nature" of the learning students experience using activity-based approaches, versus the nature of the learning using more traditional approaches?

Learning Elaboration Analysis. Three general themes emerged from this data. First, students were reported to be more excited about, enthusiastic about, and engaged in the course material. Second, students were reported to have developed a better, richer, and deeper understanding of physical phenomenon. And third, respondents noted that activity-based approaches helped make students better able to make connections between different physical phenomenon, and between physics and the "real world."

<table>
<thead>
<tr>
<th>Student learning</th>
<th>n</th>
<th>respondents</th>
</tr>
</thead>
<tbody>
<tr>
<td>Students were more engaged, had more fun with material</td>
<td>7</td>
<td>2, 12, 16, 25, 27, 42, 53</td>
</tr>
<tr>
<td>Students gained a deeper understanding of concepts</td>
<td>22</td>
<td>1, 3, 10, 14, 18, 19, 22, 30, 34, 35, 37, 43, 51, 53, 55, 56, 58-61, 63, 65</td>
</tr>
<tr>
<td>Students made more connections within course, and between course concepts and the &quot;real world&quot;</td>
<td>8</td>
<td>7, 18, 29, 49, 55, 56, 60, 69</td>
</tr>
</tbody>
</table>

Respondent 1: They understand basic ideas better.

Respondent 2: There is more enthusiasm on the students' part when activity based procedures are used.

Respondent 3: The students seem to really grasp the concepts (especially basic mechanics) rather than memorize what they need to know for a test without truly understanding it.

Respondent 7: The students can visualize the use of the concepts in lab situations and real world problems. They are able to see the "physics" in the world around them.

Respondent 10: Students build their own understanding using activity based approaches instead of being told what's correct.
Respondent 12: A lot of my students said that they enjoyed discovering concepts on their own, it helped them remember it better.

Respondent 13: Direct application, hands-on, immediate feedback.

Respondent 14: They are able to "feel" and experience the concept rather than read about it.

Respondent 15: Sensors extend range of reality and demand that students account for disparity.

Respondent 16: Students enjoy the labs more with the computer-based tools than with the old traditional equipment.

Respondent 18: Better grasp of concepts -- better able to apply to everyday situations, but not necessarily able to better solve "traditional" physics problems.

Respondent 19: With activity-based approaches, students learn understanding through a variety of applications rather than specific knowledge in one situation.

Respondent 20: The best part are ILD's. Students comment more times that "labs" don't help 1/100 as much as ILD's.

Respondent 21: Students are evenly split as to their success with the different learning strategies.

Respondent 22: They understand the concepts better.

Respondent 25: Activity-based is much more involving, interesting, and fun.

Respondent 27: Students are more engaged!

Respondent 28: Using activity-based approaches allows me to more easily recognize when learning has NOT occurred.

Respondent 29: Consequential phenomenon, in other words, you could see the results.

Respondent 30: Requires students to infer and predict; forces students to see trends and mathematical relationship between variables. Traditional is more factual: plug and chug.

Respondent 34: Learners have better understanding if they really think about what they see and do.

Respondent 35: It seems as if the learning is deeper; not so "study for the test" type of learning.

Respondent 37: They are forced to think about what is going on in the lab instead of blindly collecting data.

Respondent 39: Learning is more collaborative between students. Better problem solving skills are developed.

Respondent 42: Students at first think there is too much repetition. But as they see how well they do, most get into it. A few students and parents still expect you to "feed" all the info they need.

Respondent 43: Students gain conceptual understanding of topic instead of crunching numbers -- their answers become qualitative and quantitative.

Respondent 44: Some do begin to see the connection between the physical activity and the mathematical representations.

Respondent 47: In a traditional approach, when they get confused (i.e., learning discrepancies), they "ignore it" and just "do the math." In ABP, they are FORCED to face their confusion and they either get through it, or drop the class!

Respondent 49: RTP frustrated my students.
Respondent 51: Activity based approaches enhance learning science by doing science. Students are more involved and therefore learn deeper and in a more concrete vs. abstract way.

Respondent 53: The students enjoyed it! My classes are 40% - 50% special ed students and under-achievers -- They worked so well and grasped the concepts.

Respondent 55: Activity-based approaches -- especially TST labs and Modeling Approach -- enable students to learn physics as a more coherent body of knowledge, where the unit of knowledge is a model. With more traditional approaches, the learning is very fragmented. The unit of knowledge is the right answer to the problem.

Respondent 56: Students develop a more fundamental understanding of kinematics and are able to relate to real world. However, in non-mechanical areas, where stronger math skills help, there is little difference.

Respondent 58: More personal, deeper understanding.

Respondent 59: The conceptual pitfalls and misunderstandings are targeted by activity-based approaches.

Respondent 60: They have improved conceptual understanding and can tie it to real life situations.

Respondent 61: I feel the activity-based approach forces students to "think" more about the material.

Respondent 62: It requires more effort on their part which they are not used to.

Respondent 63: I believe students generally have a better, more thorough understanding with ABP.

Respondent 64: Students are given the opportunity and are encouraged to use technology (computers and sensors) to gather and analyze data using the experimental approach.

Respondent 65: My students were better at visualizing a graph and understanding relationships.

Respondent 67: ILD's work particularly well -- involved with activity and help with logical thinking after.

Respondent 69: Students make more connections when they can manipulate materials.

Respondent 70: Explain the situation. Students have to do a lab to prove it -- or disprove it. They will have discussions of . . . [unreadable].

36. Internal funding success (elaboration).
38. External funding success (elaboration).

Respondent 3: Re: Internal funding -- I was able to get some equipment through our district technology office. Re: External funding -- I already had much of the probe-ware and our school building has 2 wireless computer labs available for check out.

Respondent 7: Re: Internal funding -- Already had computers in the lab and PASCO setups for 8 stations. We have added more probes and data collection devices beyond the basic PassPort package. Re: External funding -- Applied for Toyota Tapestry grant -- not funded but resubmitting this year.

Respondent 9: Re: Internal funding -- I asked for and received 6 logger pro interfaces, 12 motion, 12 force, 6 radiation, and 6 accelerometers, and other assorted hardware as well.

Respondent 13: Re: Internal funding -- Got money for 3 new computers, 3 trade systems and licenses.

Respondent 15: Re: External funding -- Albertson grant for $16,000 for seven stations

Respondent 17: Re: Internal funding -- Everything I have asked for I have gotten - I am very lucky. Re: External funding -- For video analysis equipment.
Respondent 18: Re: Internal funding -- 12 iBooks, 12 lab Pros and various probes.

Respondent 20: Re: Internal funding -- I have all probes I need to do the basic; 6 tracks and all supporting equipment.

Respondent 28: Re: Internal funding -- I have been supported at this level for at least 6 years ($1800/year). Re: External funding -- I have been supported at this level for over 10 years ($800/year).

Respondent 29: Re: Internal funding -- ABPI has a good reputation for research-based initiatives.


Respondent 32: Re: Internal funding -- It took three years.

Respondent 34: Re: Internal funding -- More [unreadable] and less money for materials.

Respondent 35: Re: Internal funding -- I ordered 5 lab pros and got them all.

Respondent 36: Re: Internal funding -- Only 1 classroom computer. I need to use computers in Chem. Lab to do activities.

Respondent 37: Re: Internal funding -- We have 12 PASCO set-ups and interfaces and mechanics tracks and carts (9 setups). We are working on cameras (I have VideoPoint).

Respondent 38: Re: Internal funding -- this was a part of my normal budget request. Re: External funding -- I applied (and was denied) a Toyota Tapestry Grant for a collaborative digital video project.

Respondent 41: Re: Internal funding -- I’m working on a substantial in-house fund raiser (approved by administration).

Respondent 42: Re: Internal funding -- Administration was very supportive until I asked them to fund the lab.

Respondent 43: Re: Internal funding -- Computer and digital video requests have been denied, but most equipment we purchased over 4 years.

Respondent 44: Re: Internal funding -- Tried to get equipment for 6 lab setups. I have some, enough for 4 setups. We could probably spend another $5,000 on top of what has been spent and be pretty well equipped.

Respondent 45: Re: Internal funding -- Money was diverted to another concern.

Respondent 46: Re: Internal funding -- Gates TLP funding for computers.

Respondent 50: Re: Internal funding -- I already had 8 computers with complete Vernier setups prior to Dickinson. Re: External funding -- I am well equipped already.


Respondent 56: Re: Internal funding -- The school is very supportive and has a generous donor for physics education. No committees to ask. I get what my students need. Re: External funding -- I don't care for the controls or justification requirements that come from outside sources. Too much paperwork, too many special questions about how such-and-such will be used or measured.

Respondent 57: Re: Internal funding -- We’ve had a lot of stuff for years and we got about $8,000 more to equip new rooms with construction dollars.

Respondent 59: Re: External funding -- I was denied an external grant from Murdoch Corporation (Partners in Science) because what I would use my grant for was not closely related to my research topic.
Respondent 60: Re: Internal funding -- We have a good budget AND the high school students use equipment purchased for the university transfer courses.

Respondent 61: Re: Internal funding -- This was to obtain PASCO carts and tracks for lab. We already had VLI boxes and probes.

Respondent 62: Re: Internal funding -- They have been very supportive and I have received a $25,000 Gates Grant for classroom computers.

Respondent 63. Re: Internal funding -- So far I have not found time to apply for grants.

Respondent 64: Re: Internal funding -- We have had more support financially from external sources than from school district funding.

Respondent 64: Re: External funding -- Made part of budget so no extra funds needed.

Respondent 66: Re: Internal funding -- We requested and received financial support in order to integrate more of an ABPI approach. So far I have not found time to apply for grants.

39. Dissemination. Have you related your experiences with the ABPI approach to other teachers of physics?

Respondent 3: I will be presenting at our statewide science conference this spring.

Respondent 9: In-service for fellow staff on use of materials, soft- and hardware.

Respondent 31: District in-service.

Respondent 32: Holding in-service workshops for our physics teachers.

Respondent 47: I may have a chance in January; our local community college is trying to get all of us in the area together.


Respondent 63: I had teachers in to observe my classes and have shown teachers ideas during less structured in-service days.

41. Impediments. What impediments to fully implementing activity-based physics do you face? What could be done (in future workshops or otherwise) to help you overcome this particular impediment?

Impediments Analysis: As with the responses to Questions 26 and 27, above, “time” and “money” showed up here as the key impediments. Regarding money, several respondents suggested that the ABPI team put together a module on funding in future workshops. Regarding time, block scheduling had some support among respondents as a recommendation. One other issue related to time cropped up here, as well: mandated curriculum. A number of respondents noted that time was particularly tight because of a mandated curriculum geared to end-of-year and exams and state standards. Some suggested that activity-based teaching modules be aligned with prevailing state standards. Others suggested that teachers come together to prioritize the most important subjects so that they could be focused on. This is an important issue that probably deserves more consideration in ABPI, especially given that it relates directly to one of the program’s stated goals:

- Goal 2: Adapt and integrate research-based curricula and teaching methods into their courses in order to create opportunities for all institute participants to meet local, state and national standards at the same time evaluate the effectiveness of their curricular changes.
<table>
<thead>
<tr>
<th>Impediment</th>
<th>n</th>
<th>Respondents</th>
</tr>
</thead>
<tbody>
<tr>
<td>Funding for equipment</td>
<td>23</td>
<td>4, 5, 8, 15, 16, 19, 21, 27-29, 33, 34, 36, 39, 41, 42, 44, 47, 51, 58, 59, 61, 63</td>
</tr>
<tr>
<td>General lack of time</td>
<td>23</td>
<td>2, 3, 5, 11-13, 15, 18, 19, 22, 27-29, 33, 34, 36, 39, 41, 42, 44, 47, 51, 58, 59, 61, 63</td>
</tr>
<tr>
<td>Time issues related to mandated standards</td>
<td>8</td>
<td>7, 12, 13, 28, 38, 40, 60, 63</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Recommendation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Conduct a funding workshop at ABPI</td>
</tr>
<tr>
<td>Block scheduling</td>
</tr>
<tr>
<td>Align ABP modules with standards; discuss and set priorities and focus on them</td>
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</tbody>
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<table>
<thead>
<tr>
<th>Respondent 1 -- Impediments</th>
<th>Recommendations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Too many other students in non-physics courses.</td>
<td>Nothing you can do.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Respondent 2 -- Impediments</th>
<th>Recommendations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Insufficient equipment for good student hands-on.</td>
<td>Additional financial support.</td>
</tr>
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</table>

<table>
<thead>
<tr>
<th>Respondent 3 -- Impediments</th>
<th>Recommendations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Time -- I cannot get through my curriculum, which is admittedly far reaching when I spend time with hands-on approach (as well as set up and take down in high school where there is no lab tech to help out). I cannot get from group to group to help with basic technology issues such as interface not reading, etc. fast enough (especially with 8 or more groups working). Also, I don't know enough about the equipment to effectively troubleshoot.</td>
<td>Maybe more training in the technology support side so that I can spend more time talking with students instead of trying to figure out why the LabPro is not &quot;beeping&quot; right or there is no collect button or any number of other issues.</td>
</tr>
<tr>
<td>Paper. We are being encouraged to use less and less as we are going through budget issues. The process of ABP requires a lot of paper for predictions, results, questions, etc.</td>
<td>Try to find an on-line or less paper intensive method for doing the same things and have that format ready to go at the workshop.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Respondent 4 -- Impediments</th>
<th>Recommendations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Equipment.</td>
<td>Money.</td>
</tr>
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<table>
<thead>
<tr>
<th>Respondent 5 -- Impediments</th>
<th>Recommendations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Money for equipment and t</td>
<td></td>
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<table>
<thead>
<tr>
<th>Respondent 7 -- Impediments</th>
<th>Recommendations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Justification with the state objectives &amp; student expectations.</td>
<td>State alignment of curriculum.</td>
</tr>
<tr>
<td>Reorganization and redesign of the lab.</td>
<td>Nothing in workshop.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Respondent 8 -- Impediments</th>
<th>Recommendations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cost for updated equipment and enough probes and accessories for each student.</td>
<td>Advice on grant funding programs.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Respondent 10 -- Impediments</th>
<th>Recommendations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Large class sizes make it difficult to do an activity-based lab.</td>
<td>Including ILD's (as currently being done) is helpful to model an alternative to labs.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Respondent 11 -- Impediments</th>
<th>Recommendations</th>
</tr>
</thead>
<tbody>
<tr>
<td>TIME to revise plans -- it's easier to pull things out of the file cabinet that I am familiar with.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Respondent 12 -- Impediments</th>
<th>Recommendations</th>
</tr>
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<tbody>
<tr>
<td>Takes WAY too long, especially if you want to meet all of your standards.</td>
<td>Cut unnecessary parts, focus on one particular unit.</td>
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</table>

Lack of experience - no other physics teachers to bounce ideas off of.
<table>
<thead>
<tr>
<th>Respondent 13 -- Impediments</th>
<th>Recommendations</th>
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<tbody>
<tr>
<td>Standards and curriculum.</td>
<td>Follow up on standards; change curriculum.</td>
</tr>
<tr>
<td>Computer and tech support.</td>
<td>Time for planning to change curriculum.</td>
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<tr>
<th>Respondent 14 -- Impediments</th>
<th>Recommendations</th>
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<tbody>
<tr>
<td>Enough lab equipment for the students to work in pairs.</td>
<td>Grant writing workshops -- help put together a real proposal; grants opportunity list.</td>
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<td></td>
<td>Longer class periods.</td>
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<tr>
<th>Respondent 15 -- Impediments</th>
<th>Recommendations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Time to prepare during school years.</td>
<td>More time during school year to innovate and experiment.</td>
</tr>
<tr>
<td></td>
<td>Money.</td>
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<tr>
<th>Respondent 16 -- Impediments</th>
<th>Recommendations</th>
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<tbody>
<tr>
<td>Learning to use the software for Pasco equipment.</td>
<td>Have Pasco equipment available at workshops.</td>
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<tr>
<td>Not enough computers (some classes -- 1 computer for 6-7 students).</td>
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<tr>
<td>Not have a computer projector.</td>
<td>I have ordered one for next year.</td>
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<tr>
<th>Respondent 17 -- Impediments</th>
<th>Recommendations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unable to continue discussions with ABPI participant.</td>
<td>A couple of meetings regionally with participants throughout the year.</td>
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<tr>
<th>Respondent 18 -- Impediments</th>
<th>Recommendations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Expectations from schools and parents to &quot;cover&quot; the material.</td>
<td>Encourage similar programs in chem. and bio.</td>
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<tr>
<th>Respondent 19 -- Impediments</th>
<th>Recommendations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Time and money.</td>
<td></td>
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<tr>
<th>Respondent 20 -- Impediments</th>
<th>Recommendations</th>
</tr>
</thead>
<tbody>
<tr>
<td>I need more physics training.</td>
<td>Run another wonderful workshop! This has changed my whole approach to teaching! Thanks.</td>
</tr>
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<thead>
<tr>
<th>Respondent 21 -- Impediments</th>
<th>Recommendations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lack of and older computers.</td>
<td>Need more than 2 older computers in my classroom.</td>
</tr>
<tr>
<td>Lack of complete funding.</td>
<td>More money given to science and math departments.</td>
</tr>
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<tr>
<th>Respondent 22 -- Impediments</th>
<th>Recommendations</th>
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<tbody>
<tr>
<td>Time to learn the technology.</td>
<td>Summer program to change from traditional approach to ABP.</td>
</tr>
<tr>
<td>Help with technology.</td>
<td>Internet or phone contact (no tech staff at school).</td>
</tr>
<tr>
<td>Respondent 26 -- Impediments</td>
<td>Recommendations</td>
</tr>
<tr>
<td>------------------------------------------------------------</td>
<td>------------------------------------------</td>
</tr>
<tr>
<td>45 minutes is not enough time per day.</td>
<td>I've gone away from formal problem solving using written problems. Most problems are class or computer generated.</td>
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<tr>
<th>Respondent 27 -- Impediments</th>
<th>Recommendations</th>
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</thead>
<tbody>
<tr>
<td>Time is limited.</td>
<td>Block scheduling.</td>
</tr>
<tr>
<td>Money.</td>
<td>This is tough, considering school's financial situation.</td>
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<tr>
<th>Respondent 28 -- Impediments</th>
<th>Recommendations</th>
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</thead>
<tbody>
<tr>
<td>Personal experience using new ABP curricular materials.</td>
<td>CONTINUE to allow participants to gain experience using new ABP curricular materials</td>
</tr>
<tr>
<td>Not having needed sensors.</td>
<td>Loan a classroom set of needed sensors to teachers.</td>
</tr>
<tr>
<td>Getting students ready for end-of-year AP physics exam.</td>
<td>Provide more time for problem solving in curriculum.</td>
</tr>
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<tr>
<th>Respondent 29 -- Impediments</th>
<th>Recommendations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Getting sensors and software.</td>
<td>Broader grant resources.</td>
</tr>
<tr>
<td>Expanding classroom access to PC's.</td>
<td>Lap top PCs for physics (AIP, AAPT) program.</td>
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<tr>
<th>Respondent 30 -- Impediments</th>
<th>Recommendations</th>
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<tbody>
<tr>
<td>Language.</td>
<td>Simplify language, use middle school TST as template.</td>
</tr>
<tr>
<td>Space and facilities.</td>
<td></td>
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<tr>
<th>Respondent 33 -- Impediments</th>
<th>Recommendations</th>
</tr>
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<tbody>
<tr>
<td>Money for computers and equipment in all science rooms.</td>
<td></td>
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<tr>
<th>Respondent 34 -- Impediments</th>
<th>Recommendations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Time, amount of material, and money for equipment.</td>
<td>Have administrators agree to attend 1/2 day of workshop to see data on student improvement and equipment used.</td>
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<thead>
<tr>
<th>Respondent 35 -- Impediments</th>
<th>Recommendations</th>
</tr>
</thead>
<tbody>
<tr>
<td>My knowledge of physics is less than what it should be for the level that I teach.</td>
<td>The staff at Dickinson really helped me understand the material a lot better. I really think it's their job to help with presentation.</td>
</tr>
<tr>
<td>Time: I have actually used more of the TST this year. The students are doing even more hands on, but it takes time! I think it is a quality or quantity issue at the high school level.</td>
<td>Have class every day -- but you have to realize physics is not the most important thing in students' lives.</td>
</tr>
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<tr>
<th>Respondent 36 -- Impediments</th>
<th>Recommendations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scheduling.</td>
<td>Block scheduling.</td>
</tr>
<tr>
<td>Finance.</td>
<td>Grants.</td>
</tr>
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<tr>
<th>Respondent 37 -- Impediments</th>
<th>Recommendations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interfacing the camera with my PC laptop.</td>
<td>Bring laptops and cameras and show us how to get them to work together.</td>
</tr>
<tr>
<td>Importing video to VideoPoint.</td>
<td>We had this as an option. Make it a mandatory day of grabbing video and importing to VideoPoint with our own equipment if we have it.</td>
</tr>
<tr>
<td>Force probe and motion censor breakdowns.</td>
<td>Learn to repair these us or talk about how to minimize breakdowns. I have 8 probes out for repair.</td>
</tr>
</tbody>
</table>
**Respondent 38 -- Impediments**

Lack of physics workspace. I don't have a room to leave things set up.

Deciding what units to delete. No time to do all this with 42-minute periods.

**Recommendations**

Our school needs additional classroom space.

I need to bite the bullet and decide while still meeting the PA standards.

---

**Respondent 39 -- Impediments**

Lack of planning time and expense of equipment.

**Recommendations**

Lack of planning time and expense of equipment.

---

**Respondent 40 -- Impediments**

Because the materials are formatted differently (layout and structure) it is difficult to make a uniform curriculum with constant expectations.

The waves, sound, and optics units are very weak for high school curriculum. They focus on areas not typically covered in high school.

Some of the workshop physics units are missing.

**Recommendations**

Give all the materials the same look and feel. I would prefer that all materials be formatted in the workshop physics layout.

These materials should be updated to better reflect the high school curriculum needs and be structured in the workshop physics format.

All of the workshop materials should be available.

---

**Respondent 41 -- Impediments**

Lack of funding for equipment.

Lack of time to develop my curriculum to more fully use ABP techniques.

**Recommendations**

Grant writing and fund raising.

---

**Respondent 42 -- Impediments**

Time to learn software and equipment.

Money.

**Recommendations**

Keep the summer workshop.

Add grant writing to summer workshop or have a computer forum.

---

**Respondent 43 -- Impediments**

Technology decisions are made by the technology department, not the teachers. Therefore I have to work to convince them that technology is appropriate and affordable.

Curriculum decisions are made by curriculum office. I can recommend an approach, but it is subject to committee’s decision.

There will never be enough time to try every lab and activity that would be effective in class. The activity-based approach is effective, but it takes time.

**Recommendations**

Talk with colleagues -- How do they work with technology departments to convince and implement new curriculum.

Talk with colleagues -- How do you convince a committee? How can I write a successful grant application to obtain outside support?

How do we maximize class time? Discuss at workshop.

---

**Respondent 44 -- Impediments**

Equipment to lower group size to a maximum of 4 students.

Students are too slow to get through some activities and need assistance with getting good data. They often don't know what good data looks like.

Low math skills.

**Recommendations**

This is a hardware and funding problem. It would be nice not to have all the burden placed on the district level. I'm not sure that ABPI can do.

Time needs to be spent setting equipment up and testing it.

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<tr>
<th><strong>Respondent 45 -- Impediments</strong></th>
<th><strong>Recommendations</strong></th>
</tr>
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<tbody>
<tr>
<td>Time to fully use it and still cover the material.</td>
<td>Create a general course outline that could be used in a general physics class.</td>
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<tr>
<th><strong>Respondent 47 -- Impediments</strong></th>
<th><strong>Recommendations</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>For me, it's all about money, and this is about knowing good sources in a timely manner and having time to do the paperwork!</td>
<td></td>
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<tr>
<th><strong>Respondent 48 -- Impediments</strong></th>
<th><strong>Recommendations</strong></th>
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<tbody>
<tr>
<td>An actual lab room.</td>
<td>I will get one after school renovations (9/05).</td>
</tr>
<tr>
<td>Only 2 computers.</td>
<td>I will have 7-8 computers in 9/05 when school renovations are complete.</td>
</tr>
<tr>
<td>I teach 6 classes a day!</td>
<td>Teach only 5 classes a day (highly improbable).</td>
</tr>
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<tr>
<th><strong>Respondent 49 -- Impediments</strong></th>
<th><strong>Recommendations</strong></th>
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</thead>
<tbody>
<tr>
<td>Students do not want RTP/WSP alone.</td>
<td>Don't stick to such a rigid program. RTP WSP.</td>
</tr>
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<tr>
<th><strong>Respondent 50 -- Impediments</strong></th>
<th><strong>Recommendations</strong></th>
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<tbody>
<tr>
<td>Classroom space; equipment storage; can't leave equipment set up.</td>
<td>Build a new school.</td>
</tr>
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<tr>
<th><strong>Respondent 51 -- Impediments</strong></th>
<th><strong>Recommendations</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Obtaining hardware.</td>
<td>Sessions on how to write and obtain grants.</td>
</tr>
<tr>
<td>Adoption of activity-based instruction to fit my teaching and class schedule.</td>
<td>Practice implementation on fixed time periods.</td>
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<tr>
<th><strong>Respondent 53 -- Impediments</strong></th>
<th><strong>Recommendations</strong></th>
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<tbody>
<tr>
<td>Not enough time.</td>
<td>Need to make physical science 2 semesters instead of 1.</td>
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<tr>
<th><strong>Respondent 54 -- Impediments</strong></th>
<th><strong>Recommendations</strong></th>
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</thead>
<tbody>
<tr>
<td>Class time period.</td>
<td>Opt for ILD's.</td>
</tr>
<tr>
<td>Paper consumption.</td>
<td></td>
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<tr>
<th><strong>Respondent 55 -- Impediments</strong></th>
<th><strong>Recommendations</strong></th>
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<tbody>
<tr>
<td>Time -- even teaching 80-minute block periods for 18-week classes, I have trouble finishing mechanics.</td>
<td>Would prefer year-long 60 minute classes to cover more material using ABP.</td>
</tr>
<tr>
<td>As good as A-B physics is, it lacks an overall framework that pulls everything together into a coherent whole.</td>
<td>Expose participants to the framework of the Modeling Approach to High School Physics out of ASU, especially the mechanics curriculum.</td>
</tr>
<tr>
<td>Lack of ongoing institutional support that can help teachers over time to become more proficient with A-B methods.</td>
<td>Form alliances with local universities (Physics and Education Departments) that would help institutionalize reform.</td>
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<tr>
<th><strong>Respondent 56 -- Impediments</strong></th>
<th><strong>Recommendations</strong></th>
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<tbody>
<tr>
<td>Poor math skills. Some students are in calculus and some are still in second-year algebra.</td>
<td>The physics teacher teaches the math the students must know (math teachers won't). But this takes away from physics time.</td>
</tr>
<tr>
<td>Lecture is much more efficient for covering topics quickly. Inquiry requires time and fewer topics can be covered, but students benefit.</td>
<td>For a 1st year physics course doing well to cover by inquiry: kinematics, dynamics (non rotational), projectile and circular motion, momentum and...</td>
</tr>
</tbody>
</table>
Space -- it would be nice to leave equipment set up, but everything gets completely set up and taken down nearly every class period. Space requirements for laboratory.

**Respondent 57 -- Impediments**

- too short a school year, too many topics to teach.

**Recommendations**

- The program is designed to have student groups working on the computers. It will be quite some time until I have ample hardware.
- I don't see what the workshop could do other than political lobbying.

**Respondent 58 -- Impediments**

- ABPI curriculum demands too many hours to do labs.

**Recommendations**

- Set up time (I share many classrooms).
- ABPI curriculum demands too many hours to do labs.
- Give me my own room.
- More classroom hours.

**Respondent 59 -- Impediments**

- Funding.

**Recommendations**

- Set up time (I share many classrooms).
- ABPI curriculum demands too many hours to do labs.
- Give me my own room.
- More classroom hours.

**Respondent 60 -- Impediments**

- Too much to teach and not enough time. We must follow a very large provincially mandated course outline, leading to external exam worth 40% of the student's overall mark.

**Recommendations**

- Developing mini-labs and other activities.
- More group work and white board work.

**Respondent 61 -- Impediments**

- When difficulties with the equipment arise, I wish I had another physics teacher to talk to.

**Recommendations**

- Identify other physics teachers in the area that use the same equipment.
- Give the High School CD of the workshop -- so we now exactly what materials are available.
- More into trouble-shooting the probes. (Every time I pull them out they seem to do something strange.)

**Respondent 62 -- Impediments**

- Computers are older, probes are older, sometimes act "buggy."

**Recommendations**

- Time to allot time to certain things such as mechanics we never touch others like light waves.
- Discuss what is really important.

**Respondent 63 -- Impediments**

- Being very curriculum driven in my district.

**Recommendations**

- Lack of computers in lab.

**Respondent 64 -- Impediments**

- The primary impediment I faced in implementing the activity-based physics curriculum was that of effective time management and logistics. I have had a schedule of teaching both Chemistry and Physics for the past several years. Both of these courses are laboratory-based courses and each course requires a separate set of equipment for each lab or laboratory exercise. Both courses have been taught in the same room -- a combined Physics-Chemistry classroom. In order to organize, set up, and dismantle lab equipment for both courses taught simultaneously has required a great deal of time management, organization, and logistical preparedness.

**Recommendations**

- There is nothing in the workshop, per se, that can be done to alleviate the problem of time management, organization, or logistical support for the individual teacher. I believe this problem can best be solved at the local school district itself. For example, a teacher may be given additional preparation time (prep time) to facilitate laboratory equipment set up, disassembly, and storage. Alternatively, a lab assistant may be hired or perhaps an advanced student (AP student) may be given scholastic credit for assisting with the problem or lab equipment.
Respondent 65 -- Impediments | Recommendations
---|---
I need to time-manage better. | We went on block scheduling so the time has improved.

Respondent 66 -- Impediments | Recommendations
---|---
Time to revise current curriculum | Longer workshop to write curriculum (less labs 2nd year)

Respondent 67 -- Impediments | Recommendations
---|---
Stresses put on teachers with extra tests and requirements - - we have a lot less time to teach (lots of teachers are retiring early).

42. Final remarks. If there is anything else you would like to comment on, I would appreciate hearing your thoughts so that they might be incorporated into my final report.

Final Remarks Analysis. The final remarks made by respondents were extraordinarily positive. Respondents do not often take the opportunity to make summary remarks after a lengthy survey such as this one. But here, 45 of 70 respondents (64%) took the time to do so. And 39 of those 45 comments (87%) related glowing comments and words of thanks to all who were involved in making the ABPI workshops the success they were judged as being. Several respondents (10, 12, 15, and 30) made specific note about the value of the teacher-to-teacher interactions, reinforcement of the first-place ranking of this aspect in Survey Section III, Chart 3.1). Two other respondents (3 and 61) made specific mention of the importance of the second year of the workshop to the overall learning accomplished (as discussed in Survey Section III, see Chart 3.4).

Respondent 1: It was a fantastic 4-week experience. I learned more than I could have imagined.

Respondent 2: The ABPI was extremely valuable to me. I have adapted other demonstrations to the ILD format.

Respondent 3: A 2-year program is essential. I had not used any of the equipment prior to my 1st summer so I was quickly overwhelmed. After getting to come back to school and try things out I needed to get back together and re-assimilate and re-charge to get through the learning curve.

Respondent 7: Great experience! the beginning of computer-based learning in physics that truly meant the students were learning and not doing multiple-guess, programmed learning.

Respondent 10: ABPI is among the BEST professional development experiences I have had, because we had time to work through lab and activities on our own (in small groups) AND the live-in arrangements allowed lots of time for informal conversations.

Respondent 12: It was a great experience; the best part was talking with other, more experienced teachers.

Respondent 13: Workshops were great; instructors were great; activities were great; this program should get very high priority for funding.

Respondent 14: The opportunity provided me both with a better conceptual understanding and better teaching practices to use with my students. They can build an understanding rather than read for understanding. I would like to extend this to other teachers.

Respondent 15: The unfettered time with colleagues is simply the best. I would love a workshop where we could just work with what we want to develop over 2-3 weeks.

Respondent 16: I think I would have benefited more in the second year by doing more structured activities (labs) rather than so much time being devoted to the energy project.

Respondent 17: These experiences have been excellent and have directly impacted my students and have made me a better teacher.
Respondent 18: My only disappointment was that the list serve was not used very extensively -- lost touch with colleagues fairly quickly, except those who regularly attend AAPT.

Respondent 20: Wonderful, wonderful workshop! Thanks.

Respondent 23: Although I am not a physics teacher, my participation in ABPI has resulted in greater support for physics teachers in my district.

Respondent 25: Workshop physics has been my primary curricular for the past 7 years. I could not imagine going back to a traditional approach.

Respondent 26: As one of my instructors at Dickinson said, just ask for help if support is needed.

Respondent 27: ABPI was a wonderful experience -- one I highly recommend to others!!

Respondent 28: I’m very grateful to be ending my physics teaching career using activity based physics curriculum materials. Otherwise I don’t think I could have made it another five years.

Respondent 29: Experiences and technological wherewithal has changed how I talk about and lead experiences in physics for my students.

Respondent 30: One of the most valuable aspects of the workshop involved the constant interaction with like-minded physics teachers. Being able to spend time with these experts really expanded my teaching philosophy and methods. These aspects include the other participants, the instructors, and supporting cast (TA’s, etc.).

Respondent 31: ABPI was one of the most useful workshops I have ever attended. We had time to work with equipment and perform labs. We learned the mechanics and techniques to perform the demos.

Respondent 33: ABPI is great for teachers. keep up the good work. Help from NSF is certainly appreciated.

Respondent 34: It was great experience. I only wish my district would have been more flexible on my attending the second session.

Respondent 35: I really enjoyed my time at Dickinson. The staff was excellent, as were the facilities. I found all the teachers willing to share knowledge and technique. I would not be anywhere near as confident today if it were not for the Dickinson workshop. I teach in a small rural school both in areas of expertise and out (physics), but Dickinson has helped me rise to the challenge! Thank you.

Respondent 37: I love using probes in my lab. PASCO needs to make them more student-durable! Are other teachers having these breakdowns in equipment? VERY worthwhile workshop!

Respondent 39: Excellent program. The best I’ve had as far as professional training. HIGHLY effective methods.

Respondent 40: I hope that additional workshops can be held where we can work on some of these issues to continue to improve and refine this curriculum.

Respondent 41: I love teaching physics more than ever, and am eager to continue to develop our science program using activity-based techniques. Thanks to all involved in ABPI.

Respondent 42: In 20 years of teaching -- the best workshop.

Respondent 43: The activity-based approach has truly changed how I think and teach. I would love to hear how other teachers have changed their teaching, as well.

Respondent 44: The institutes really helped me feel that I became a more competent physics teacher and boosted my confidence. The approach is time consuming and students need a lot of guidance, which spreads me out too thin and allows less self-directed groups to drift. A fantasy I have is of networked computers that can be accessed by a central server (me) to follow program without running around so much.
Respondent 45: I have really benefited from this experience. Thanks!

Respondent 48: ABPI was excellent! Even with no lab periods, I can do labs (albeit hurriedly) in 40-minute periods using LBLZ’s and LabPro’s!

Respondent 51: Of all the workshops I have attended, none have so profoundly affected my everyday teaching. I feel like I know more about what I want my program to represent.

Respondent 53: Wonderful program. Kids grasp concepts and remember them and can apply to everyday situations.

Respondent 55: The strength of this program is the diversity of ways (TST, RTP, WP, etc.) in which a physics teacher may implement an activity-based approach.

Respondent 56: When we left the institute, non-mechanical inquiries were in development but not ready for publication. Have heard nothing in two years if such things matured or died. ABPI was well developed for mechanics (velocity, acceleration, force, momentum, energy). The non-mechanical areas seem to be struggling to be part of the approach, but a 1st year high school course needs to cover more than just mechanics.

Respondent 57: I was impressed with the way the instructors adapted to the recommendations of the participants. It is critical teacher workshop leaders MODEL what we want to go on in the classrooms and this group did a marvelous job at it. Thanks to ALL.

Respondent 58: I had a great time doing the workshops.

Respondent 60: ABP has definitely changed the way I teach and I will continue to share the ideas with other science teachers.

Respondent 61: This was the best professional development I have attended in my career [5 years]. (I attended 1 or 2 PD workshops or classes each summer.) It was well paced -- not too much with enough time to digest the info. I felt it was VITAL that we attend the 2nd summer. This is where I began to feel confident using the probe-ware. I wish there was an alumni refresher course (1 week in summer?). I keep trying to go further -- using more and more probe-ware. I would attend with new eyes -- asking for help in integrating it into MY classroom. This truly made me a better physics teacher! (I also need to get back into the list serve.)

Respondent 62: I appreciated the program a lot and only wish I could use it more.

Respondent 64: Being primarily a chemistry teacher during my first years of teaching, I had subsequently become certified in Physics and welcomed the opportunity of workshops and summer sessions dealing with new approaches to teaching physics. The Workshop Physics and Activity Based Physics Institutes at Dickinson were extremely valuable in learning up-to-date instructional and laboratory methods of teaching Physics. I had been taught via the traditional method (note taking and memorization, primarily) and learned at the ABPI sessions that the learner should be the “principle investigator” in acquiring the knowledge and learning the concepts of Physics.

Respondent 65: My experience in Oregon was fantastic. The instructors were great. John Garrett really helped all the participants. You can teach an old dog new and improved tricks!

Respondent 69: I no longer teach physical science where I used much of the ABPI curriculum. If I do go back to teaching physical science or physics I will definitely use my materials (and maybe sign up for a refresher!).
APPENDIX III: ABPI Workshop Materials
Workshop schedules for the East Coast workshop at Dickinson for 2000-01 and 2002-03
Flyer announcing the Activity Based Physics Institutes (ABPI)
Description of the Activity Based Physics High School CD
Workshop schedules for the East Coast workshop at Dickinson for 2000-2001

ACTIVITY BASED PHYSICS INSTITUTE SCHEDULE
SESSION I: June 18-30, 2000

Each day during the first week has 4 blocks of 90 minutes each. There will be a 5th block on some evenings.

Block 1 is 8:20 to 9:50 am
Block 2 is 10:10 to 11:40 pm
Block 3 is 1:00 to 2:30 pm
Block 4 is 2:50 to 4:20 pm
Block 5 is 6:30 to 8:00 pm (unless otherwise specified)

Breaks are held at 9:50 AM and 2:30 PM. Lunch is 11:40 AM - 1:00 PM.

WEEK ONE

SUNDAY, JUNE 18
6:00-9:00 PM   Welcome Banquet and Introductions (Union Station in the Holland Union Building)

MONDAY, JUNE 19

BLOCK 1: INTRO TO INSTITUTE CURRICULUM/CONCEPTUAL EVALUATION I
- Overview of Institute Curriculum (15 min)
- Plenary Discussion on Research Basis of FMCE and ECCE (30 min)
- Breakout group discussion on how students might respond to selected FMCE questions based on actual classroom experience or intuition—we pick some samples. (45 min)

BLOCK 2: CONCEPTUAL EVALUATION II/INTRO TO CURRICULAR MATERIALS
- Groups share outcomes of breakout discussions (45 min)
- Plenary session to compare predictions w/ data on student performance and their own pretest data (25 min)
- Introduction to Curricular Materials w/ emphasis on what environments they were designed for. These include HRWC, TST, RTP, WP, WPS, and ILD’s. (20 min)

BLOCK 3: MEASUREMENT AND UNCERTAINTY I (WP Unit 2)
- Overview Discussion (15 min)
- Key Technical Points (5 min)
- Guided Inquiry: WP Activities 2.2–2.8 (70 min)

BLOCK 4: MEASUREMENT AND UNCERTAINTY II
- Guided Inquiry (continued): WP Activities 2.2–2.8 (40 min)
- Mini-project: Indirect Measurement of Height of Observatory Dome (30 min)
- Sharing Outcomes of Mini-project (10 min)
- Demo of Nuclear Decay Distribution Function and Wrap Up (10 min)
  (Leave source and sensor out at one station for follow-up work)

5:00 PM   Pre-dinner Social (2ND Floor Terrace)

6:30 PM   Introduction to VideoPoint Software & Computer Time (continue w/ Nuclear Decay /Exploration of Software on Network)
TUESDAY, JUNE 20
BLOCKS 1-2: KINEMATICS CONCEPTS w/ TST & RTP
• Overview Discussion (15 min)
• Key Technical Points (5 min)
• Guided Inquiry: TST Lab 1 & RTP Lab 2 (130 min)
• Mix and match RTP Extensions (20 min)
• Sharing Outcomes of Extensions (10 min)

BLOCKS 3-4: MODELING & MATHEMATICS FOR CONSTANT ACCELERATION
• Overview Discussion (15 min)
• Key Technical Points (5 min)
• Modeling w/ WP Activities 1.6-1.7 (w/ HW), 4.6 as "ILD", 4.7 as hands-on (130 min)
  (Note: Demo VideoPoint w/ PASCO035.mov to get data for parabolic modeling)
• Mini-project on modeling: Fan carts w/ different thrusts using VideoPoint (20 min)
• Sharing Outcomes of Mini-project (10 min)

BLOCK 5: FORCE & MOTION I
  • Show calibration of Force Sensor
  • RTP Lab 3 Act 2-1 through 2-5 as an interactive group activity (60 min)

WEDNESDAY, JUNE 21
BLOCK 1: FORCE & MOTION II
• Guided Inquiry: RTP Lab 4 Activities 1-1 and 1-2, Activity 3-1 (60 min)
• Mix and match RTP Extensions (20 min)
• Sharing outcomes of Extensions

BLOCK 2: FORCE & MOTION III
• Guided Inquiry: RTP Lab 5 Activities 1-1 through 2-2 (70 min)
• Overview Discussion on New Mechanics Sequence (20 min)

BLOCKS 3-5:
1:00 PM Depart for Whitaker Center in Harrisburg in College vans
2:00 PM Visit Science Museum (Break as needed in Strawberry Square)
  Hands on with Mechanics and Electricity w/critique
4:00 PM Discussion of how exhibits could be used or improved for HS instruction
4:30 PM Lecture on the Physics of Dance in Science Theater
5:30 PM Dinner in Strawberry Square (vans return to Carlisle w/some participants)
7:00 PM Optional: Ballet Performance (Central PA Youth Ballet June Show in Sunoco Theater)
9:00 PM Vans return to Carlisle with performance attendees

THURSDAY, JUNE 22
BLOCKS 1-2: ELECTRICITY I
• Overview Discussion (15 min)
• Key Technical Points (5 min)
• Guided Inquiry (130 min)
• Mini-project on Electricity I Concepts (20 min)
• Sharing Outcomes of Mini-project (10 min)

BLOCKS 3-4: ELECTRICITY II
• Overview Discussion (15 min)
• Key Technical Points (5 min)
• Guided Inquiry (130 min)
• Mini-project on Electricity II Concepts (20 min)
• Sharing Outcomes of Mini-project (10 min)

**BLOCK 5: INTERACTIVE LECTURE DEMO OVERVIEW DISCUSSION (60 min)**

**FRIDAY, JUNE 23**

BLOCKS 1-2: INTERACTIVE LECTURE DEMO PREPARATION/ DELIVERY
- Team formation and ILD segment selections (20 min)
- ILD Preparation by Teams (100 min)
- Begin delivery in Breakout Sessions (60 min)

**BLOCK 3: INTERACTIVE LECTURE DEMONSTRATION DELIVERY (90 min)**

**BLOCK 4: ILD WRAP UP/IMPLEMENTATION PLANNING FOR WEEK TWO**
- Wrap Up Discussion: Critique of trends in delivery problems (20 min)
- Brainstorming on Week Two Activities (20 min)

5:00 PM Picnic at the Laws' with Volleyball and Barbecue

**WEEK TWO**  
**Updated 6/28/00**

**MONDAY, JUNE 26**

BLOCK 1: PROJECT PLANNING (EQUIPMENT & FACILITIES) (60 min)

BLOCK 2: HANDS-ON OPEN INQUIRY (Shoelaces, Tower, or Cube plus discussion of role of open inquiry in meeting standards) (120 min)

BLOCKS 3-4: PROJECT WORK

BLOCK 5: NEW COMPUTER TOPICS: VIDEO CAPTURE (Optional)

**TUESDAY, JUNE 27**

BLOCK 1:
- Announcements
- KINEMATICS PROBLEM SOLVING (COLLABORATIVE)
  - Overview discussion (15 min)
  - Key technical points for collaborative problem solving (5 min)
  - WP Activities 4.8, 4.9 or Challenge problems w/Morse Worksheets (50 min)
  - Discussion (20 min)

BLOCKS 2-4: PROJECT WORK

BLOCK 5: ACTION RESEARCH—A CASE STUDY (Willis, Jermacans)

**WEDNESDAY, JUNE 28**

BLOCK 1:
- Announcements
- Highlights of plans for 2000-2001 SY and 2001 ABPI (sharing experience, energy topics, project work and teacher/leader activities)
- Preliminary discussion of assessment and implementation of action research
- Discussion of membership in AAPT and NSTA
BLOCK 2: ASSESSMENT: IMPLEMENTING ACTION RESEARCH

BLOCK 3: 2D FORCE AND MOTION

BLOCK 4-5: PROJECT WORK

THURSDAY, JUNE 29
BLOCKS 1-2:
- Announcements
- Assessment: Implementing action research
- Project Work

BLOCKS 3-4: PROJECT PRESENTATIONS I (180 min)
- Participants will speak (10 min each)
  Note: Participants will be asked to include discussion of how their plans help meet standards.

FRIDAY, JUNE 30
BLOCKS 1-2: PROJECT PRESENTATIONS I (120 min)
- Participants will speak (10 min each)
- Wrap up discussion on most effective forms of school year support (20 min)

12:00 Noon FAREWELL LUNCHEON (2nd Floor Terrace)
Each day during the first week has 4 blocks of 90 minutes each. There may be an optional 5th block on some evenings. Optional Evening Sessions are 6:30 to 8:00 PM (unless otherwise specified.)

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<tr>
<th>BLOCK TIMES</th>
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<td>Block 1 is 8:20 to 9:50 AM</td>
<td>Mechanical Energy: Maxine Willis</td>
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<td>Block 2 is 10:10 to 11:40 PM</td>
<td>Sound: Pat Cooney</td>
</tr>
<tr>
<td>Block 3 is 1:00 to 2:30 PM</td>
<td>Optics: Priscilla Laws</td>
</tr>
<tr>
<td>Block 4 is 2:50 to 4:20 PM</td>
<td>Thermodynamics: Marty Baumberger</td>
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<tr>
<td></td>
<td>Nuclear Radiation: Priscilla Laws</td>
</tr>
</tbody>
</table>

Daily announcements will be posted on CourseInfo.

Breaks are held at 9:50 AM and 2:30 PM. Lunch is 11:40 AM - 1:00 PM.

WEEK ONE

SUNDAY, JUNE 17
6:00-9:00 PM Welcome Back Picnic in the Laws’ yard (Rain location in the New Science Building.)

MONDAY, JUNE 18
BLOCK 1-4: INTRO TO INSTITUTE CURRICULUM / BEGIN MECHANICAL ENERGY ACTIVITIES
- Overview of Institute Curriculum (15 min.)
- Plenary Presentations (30 min.) (Wingate / Friedman / Carle / Henning / Adams / Corcoran)
- Begin Mechanical Energy Minicourse (315 min.)

5:00 PM Pre-dinner Social (2nd Floor Terrace)

TUESDAY, JUNE 19
BLOCK 1: FINISH MECHANICAL ENERGY MINICOURSE (60 min.)
- Wrap-up Discussion (30 min.)

BLOCKS 2-4: BEGIN MINICOURSE ONE (270 min.)
Participants will attend one of the following:
- Sound
- Optics

CourseInfo Reflections due by 8:00 AM Wednesday

WEDNESDAY, JUNE 20
BLOCKS 1-2: FINISH MINICOURSE ONE (180 min.)
- Plenary Presentations (30 min.) (Padula / Barrick / Taylor / Withers / Alwine / Bolek)
- Finish Activities (120 min.)
- Wrap up discussion (30 min.)

BLOCK 3-4: BEGIN MINICOURSE TWO (180 min.)
Participants will attend one of the following:
- Optics
- Thermodynamics

**THURSDAY, JUNE 21**

BLOCKS 1-3: FINISH MINICOURSE TWO (270 min)
- Plenary Presentations (30 min.) (Radcliff / Twiss / Burger / Gerdes / Hapka / Kriley)
- Finish activities (210 min.)
- Wrap up discussion (30 min.)

BLOCK 4: BEGIN MINICOURSE THREE (90 min)
Participants will attend one of the following:
- Sound
- Nuclear Radiation

5:00 PM Informal Buffet Dinner (2nd Floor Terrace)

*CourseInfo Reflections due by 8:00 AM Friday*

**FRIDAY, JUNE 22**

BLOCKS 1-4: FINISH MINICOURSE THREE (360 min)
- Plenary Presentations (30 min) (Lahr / Benko / Kreitzer / McSwigan / Leiby / Miller)
- Finish activities (300 min)
- Wrap up discussion (30 min)

**WEEK TWO**

**MONDAY, JUNE 25**

Organization/Preparation of Capstone Minicourse on Energy Transformations (and other projects designed by participants.)
- Plenary Presentations (25 min) (Rudosky / Shiner / Skinner / Stanbery / Weinstein)

*CourseInfo Reflections due by 8:00 AM Tuesday*

**TUESDAY, JUNE 26**

Preparation of the Capstone Minicourse and other projects

**JOINT ACTIVITIES WITH WORKSHOP PRECALCULUS SEMINAR PARTICIPANTS:**
5:00 PM Dinner (Union Station)
6:30 PM New physics and math pedagogy (NSB 115) followed by ice cream social (2nd Floor Terrace)

**WEDNESDAY, JUNE 27**

Preparation of the Capstone Minicourse and other projects

**THURSDAY, JUNE 28**

BLOCKS 1-4: BEGIN 6-BLOCK CAPSTONE MINICOURSE ON ENERGY TRANSFORMATIONS (360 min)

*Final CourseInfo Reflections due before departure.*
FRIDAY, JUNE 29

BLOCKS 1-2: COMPLETE CAPSTONE MINICOURSE (180 min)
• Finish Activities (120 min)
• Wrap up discussion (60 min)

12:00 NOON FAREWELL LUNCHEON (2nd Floor Terrace)
ACTIVITY BASED PHYSICS INSTITUTE SCHEDULE
SESSION I: June 16-28, 2002

Each day during the first week has 4 blocks of 90 minutes each

Block 1 is 8:20 to 9:50 am  
Block 2 is 10:10 to 11:40pm  
Block 3 is 1:00 to 2:30pm  
Block 4 is 2:50 to 4:20pm

Breaks are held at 9:50 AM and 2:30 PM. Lunch is 11:40 AM - 1:00 PM.

WEEK ONE

SUNDAY, JUNE 16
6:00-9:00 PM Welcome Banquet and Introductions (Union Station in the Holland Union Building)

MONDAY, JUNE 17
BLOCK 1: INTRO TO INSTITUTE CURRICULUM/CONCEPTUAL EVALUATION I
- Overview of Institute Curriculum (15 min)
- Plenary Discussion on Research Basis of FMCE and ECCE (30 min)
- Complete the FMCE (45 min)

BLOCKS 2-3: KINEMATICS CONCEPTS w/ TST
- Overview Discussion (15 min)
- Key Technical Points (5 min)
- Guided Inquiry: TST Lab 1 & Lab 2 (140 min)
- Discussion: How does the TST curriculum seem to differ from traditional instruction? (20 min)

BLOCK 4: CONCEPTUAL EVALUATION II/INTRO TO CURRICULAR MATERIALS
- Plenary session to compare predictions w/ student and participant pretest data (30 min)
- Introduction to Blackboard: Pictures and Profiles (60 min)

5:00 PM Pre-dinner Social w/ Group Physics Activity (Tome 2ND Floor Terrace)
6:30-8:30 PM Open Labs for MBL Practice and Reflections (Instructors will be on hand)

Course Reflections due by 8:00 AM Tuesday, June 18.

TUESDAY, JUNE 18
BLOCKS 1-2 MODELING & MATHEMATICS FOR CONSTANT ACCELERATION
- Overview Discussion (15 min)
- Key Technical Points (5 min)
- Modeling w/ WP Activities 1.6-1.7, 4.6, 4.7 (130 min)
- Mini-project on modeling: Fan carts w/ different thrusts using VideoPoint (20 min)
- Sharing Outcomes of Mini-project (10 min)

BLOCK 3: MEASUREMENT AND UNCERTAINTY I (WP Unit 2)
- Overview Discussion (15 min)
- Key Technical Points (5 min)
- Guided Inquiry: WP Activities 2.2–2.8 (70 min)
BLOCK 4: MEASUREMENT AND UNCERTAINTY II
• Guided Inquiry (continued): WP Activities 2.2–2.8 (40 min)
• Mini-project: Indirect Measurement of Height of Observatory Dome (30 min)
• Sharing Outcomes of Mini-project (10 min)
• Discussion: Compare and contrast WP w/traditional instruction and TST

6:30-8:30 PM Open Labs for MBL Practice and Reflections (Instructors will be on hand)

Course Reflections due by 8:00 AM Wednesday, June 19.

WEDNESDAY, JUNE 19
BLOCK 1: FORCE & MOTION I
• Guided Inquiry: RTPM Lab 3 Act 2-1 through 2-5 (90 min)

BLOCK 2: FORCE & MOTION II
• Guided Inquiry: RTPM Lab 4 Activities 1-1 and 1-2, Activity 3-1 (60 min)
• Mix and match RTP Extensions (20 min)
• Sharing outcomes of Extensions

BLOCK 3: FORCE & MOTION III
• Guided Inquiry: RTPM Lab 5 Activities 1-1 through 2-2 (70 min)
• Overview Discussion on New Mechanics Sequence (20 min)

BLOCK 4:
2:45 PM Depart for Whitaker Center in Harrisburg in College vans
3:45 PM Visit Science Museum (Break as needed in Strawberry Square)
Hands on with Mechanics and Electricity Activities
5:15 PM Vans return to Dickinson w/ those not staying for optional events
5:30 PM OPTIONAL: Box Dinner in Strawberry Square (vans return to Carlisle w/some participants)
6:35 PM OPTIONAL: Baseball Game on City Island - Harrisburg Senators vs. Erie Sea Wolves
7:00 PM OPTIONAL: Ballet Performance (Central PA Youth Ballet June Show in Sunoco Theater)
9:00 PM Vans return to Carlisle with performance attendees

THURSDAY, JUNE 20
BLOCKS 1-2: INTERACTIVE LECTURE DEMO PREPARATION/ DELIVERY
• ILD Overview (60 min)
• Formation of 4 teams of 7-8 people and ILD segment selections (20 min)
• ILD Preparation by Teams (100 min)

BLOCK 3: INTERACTIVE LECTURE DEMONSTRATION DELIVERY (90 min)

BLOCK 4: ILD WRAPUP/INTRODUCTION TO HIGH SCHOOL CD MATERIALS
• ILD Wrap Up: Discussion of common delivery problems (20 min)
• Discussion: Compare and contrast ILD's w/other teaching methods (20 min)
• High School CD: Exploration of Materials (50min)

5:00 PM Dinner with Precalculus Workshop participants (Stern Center Great Room)

6:30 PM Talk on Combined Math and Physics Teaching (Maxine Willis, Sue Fehringer) (Tome 115)

7:30 PM Ice Cream Social w/ Precalculus Workshop participants (Tome 2nd Floor & Terrace)

Course Reflections due by 8:00 AM Friday, June 21.
FRIDAY, JUNE 21
BLOCKS 1-2: ELECTRICITY I
• Overview Discussion & Key Technical Points (20 min)
• Guided Inquiry: WP Activities 22.2 through 22.12 (160 min)

BLOCKS 3-4: ELECTRICITY II
• Overview Discussion & Key Technical Points (20 min)
• Guided Inquiry: RTPE Lab 1 Activities 1-1 through 1-5, Lab 2 Investigation 2, Lab 3 Activity 2-2 & Investigations 2 & 3, and Lab 5 All (140 min)
• Brainstorming on Week Two Activities (20 min)

Course Reflections due by 8:00 AM Monday, June 24.

WEEK TWO

MONDAY, JUNE 24
BLOCK 1: PROJECT PLANNING (EQUIPMENT & FACILITIES) (60 min)
BLOCK 2: Share-A-Thon (120 min)
BLOCKS 3-4: PROJECT WORK

TUESDAY, JUNE 25
BLOCK 1: ASSESSMENT: IMPLEMENTING ACTION RESEARCH

BLOCKS 2-4: PROJECT WORK

Course Reflections due by 8:00 AM Wednesday, June 26.

WEDNESDAY, JUNE 26
BLOCK 1: 2D FORCE AND MOTION
• WP Activities 6.6 through 6.11

BLOCK 2-4: PROJECT WORK

THURSDAY, JUNE 27
BLOCK 1: KINEMATICS PROBLEM SOLVING (COLLABORATIVE)
• Overview discussion (15 min)
• Key technical points for collaborative problem solving (5 min)
• WP Activities 4.8, 4.9 or Challenge problems w/Morse Worksheets (50 min)
• Discussion (20 min)

BLOCK 2: PROJECT WORK

BLOCKS 3-4: PROJECT PRESENTATIONS I (180 min)
• Participants will speak (10 min each)
  Note: Participants will be asked to include discussion of how their plans help meet standards.
5:30 PM Picnic at Laws’ with Barbecue and Volleyball

Course Reflections due by 8:00 AM Friday, June 28.

FRIDAY, JUNE 28
BLOCKS 1-2: PROJECT PRESENTATIONS I (120 min)
• Participants will speak (10 min each)
• Wrap up discussion on most effective forms of school year support (20 min)

12:00 Noon Sandwich Lunch (Tome 2nd Floor Terrace)
ACTIVITY BASED PHYSICS INSTITUTE SCHEDULE
SESSION II: June 15-27, 2003

Each day during the first week has 4 blocks of 90 minutes each. There may be an optional 5th block on some evenings. Optional Evening Sessions are 6:30 to 8:00 PM (unless otherwise specified.)

<table>
<thead>
<tr>
<th>BLOCK TIMES</th>
<th>MINICOURSE INSTRUCTOR ASSIGNMENTS</th>
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</thead>
<tbody>
<tr>
<td>Block 1 is 8:20 to 9:50 AM</td>
<td>Mechanical Energy: Maxine /Priscilla (Marty)</td>
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<tr>
<td>Block 2 is 10:10 to 11:40 PM</td>
<td>Sound: Pat /Marty</td>
</tr>
<tr>
<td>Block 3 is 1:00 to 2:30 PM</td>
<td>Optics &amp; Vision: Priscilla /Maxine</td>
</tr>
<tr>
<td>Block 4 is 2:50 to 4:20 PM</td>
<td>Thermal Energy: Marty /Pat</td>
</tr>
</tbody>
</table>

Daily announcements will be posted on CourseInfo.

Breaks are held at 9:50 AM and 2:30 PM. Lunch is 11:40 AM - 1:00 PM.

**WEEK ONE**

**SUNDAY, JUNE 15**
6:00-9:00 PM    Welcome Back Picnic behind Community Studies Center, 249 W. Louther (Rain location in the Tome Scientific Building.)

**MONDAY, JUNE 16**
7:30-8:15 AM    Registration for participants wanting graduate credit (Room 204)

BLOCK 1-4: INTRO TO INSTITUTE CURRICULUM / BEGIN MECHANICAL ENERGY ACTIVITIES
- Overview of Institute Curriculum (15 min.)
- Plenary Presentations (30 min.) (Cannon / Friedman / Gregorian-Michaelsen / Andersen / Stein / Angle)
- Begin Mechanical Energy Minicourse (315 min.)

**TUESDAY, JUNE 17**
BLOCK 1: FINISH MECHANICAL ENERGY MINICOURSE (60 min.)
- Wrap-up Discussion (30 min.)

BLOCKS 2-4: BEGIN THERMAL ENERGY MINICOURSE (270 min.)
6:30 PM    Share-A-Thon (Optional)

*CourseInfo Reflections due by 8:00 AM Wednesday*

**WEDNESDAY, JUNE 18 – NOTE:** Block 1 will begin at 8:00 AM today only.

BLOCKS 1-2: FINISH THERMAL ENERGY MINICOURSE (210 min.)
- Finish Activities (120 min.)
- Wrap up discussion (30 min.)
- The Physics of Dance by Kenneth Laws (60 min.)

BLOCK 3-4: BEGIN SOUND MINICOURSE (180 min.)
THURSDAY, JUNE 19
BLOCKS 1-3: FINISH SOUND MINICOURSE (270 min)
• Plenary Presentations (30 min.) (Hoffman / Goodnack / Crookston / Hanlon / Lear / Lightfoot)
• Finish activities (210 min.)
• Wrap up discussion (30 min.)

BLOCK 4: BEGIN OPTICS AND VISION MINICOURSE (90 min)
5:00 PM Informal Buffet Dinner (2nd Floor Terrace)
7:30 PM Central Pennsylvania Youth Ballet Performance at Whitaker Center (Optional)

CourseInfo Reflections due by 8:00 AM Friday

FRIDAY, JUNE 20
BLOCKS 1-4: FINISH OPTICS AND VISION MINICOURSE (360 min)
• Plenary Presentations (30 min) (Martin / Plock / Morris / Speed / Tarman / Zachery)
• Finish activities (300 min)
• Wrap up discussion (30 min)

WEEK TWO

MONDAY, JUNE 23
Organization/Preparation of Capstone Minicourse on Energy Transformations (and other projects designed by participants.)
• Plenary Presentations (30 min) (Baltzer / Connelly / Borkowski / Dake / Olson / Pinci)
10-11:00 AM Kinesthetic Physics by Hans Pfister (Room 103)
6:30 PM Dirty Bombs by John Luetzelschwab (Room 103)

CourseInfo Reflections due by 8:00 AM Tuesday

TUESDAY, JUNE 24
Preparation of the Capstone Minicourse and other projects
• Plenary Presentations (15 min.) (D. Sabatino / Tingler / Cullen (?))
6:35 PM Harrisburg Senators vs. Erie Sea Wolves (Optional)

WEDNESDAY, JUNE 25
Preparation of the Capstone Minicourse and other projects

THURSDAY, JUNE 26
BLOCKS 1-4: BEGIN 6-BLOCK CAPSTONE MINICOURSE ON ENERGY TRANSFORMATIONS (360 min)

Final CourseInfo Reflections due before departure.
FRIDAY, JUNE 27

BLOCKS 1-2: COMPLETE CAPSTONE MINICOURSE (180 min)

- Finish Activities (120 min)
- Wrap up discussion (60 min)

12:00 NOON    FAREWELL LUNCHEON (2nd Floor Terrace)
Flyer announcing the Activity based Physics Institutes (ABPI)

Dickinson College
Department of Physics and Astronomy
PO Box 1773
Carlisle, PA 17013

NSF SUMMER INSTITUTES FOR HIGH SCHOOL TELECHERS
June 18-30, 2000 (Starter)
June 17-29, 2001 (Follow-up)

Activity Based Physics and Physical Science Teaching
East Coast site: Dickinson College
West Coast site: University of Oregon
Each participant will attend a professional development institute during the summers of 2000 and 2001, either at Dickinson College in Carlisle, Pennsylvania or at the University of Oregon in Eugene, Oregon.

<table>
<thead>
<tr>
<th>Participants will Learn:</th>
<th>Benefits to Participants:</th>
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<tbody>
<tr>
<td>• To adapt activity based curricula to state and national standards</td>
<td>• Sample curricular materials</td>
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<tr>
<td>• To implement new teaching methods based on physics education research</td>
<td>• $1000 stipend upon completion of both Sessions I and II of the Institute</td>
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<tr>
<td>• To use computer tools for inquiry</td>
<td>• Free room and board at each session</td>
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<tr>
<td>• To assess new pedagogical techniques</td>
<td>• Up to $200 assistance each summer for travel to Institute site</td>
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<tr>
<td>• To overcome implementation barriers</td>
<td>• Opportunities for graduate credit or Continuing Education Units (CEUs)</td>
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<tr>
<td>• To become leaders in local educational reform</td>
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</tbody>
</table>

Who Should Participate:
High School Teachers (Grades 9-12) who teach physics and physical science courses and School Administrators. Teams are especially welcome.

For More Information and Application Materials:
Consult our web site at: http://physics.dickinson.edu/ABPIInstitutes or contact: Gail Oliver, Department of Physics & Astronomy, Dickinson College, Box 1773, Carlisle, PA 17013
Office: 717/245-1845, FAX: 717/245-1642, Email: oliver@dickinson.edu
Application Deadline: February 14, 2000

Instructors:

<table>
<thead>
<tr>
<th>EAST COAST SITE: DICKINSON COLLEGE</th>
<th>WEST COAST SITE: UNIVERSITY OF OREGON</th>
</tr>
</thead>
<tbody>
<tr>
<td>Patrick Cooney (Millersville University)</td>
<td>David Sokoleff (University of Oregon)</td>
</tr>
<tr>
<td>Maxine Willis (Gettysburg Area High School)</td>
<td>Ronald Thornton (Tufts University)</td>
</tr>
<tr>
<td>Priscilla Laws (Dickinson College)</td>
<td>John Garrett (Science Education Consultant)</td>
</tr>
</tbody>
</table>

Funded by National Science Foundation Grant No. ESI-0819626
DATE: July 31, 2001

TO: Activity Based Physics High School CD License Holders

FROM: Priscilla Laws (ABP Institute Coordinator), Marty Baumberger, John Garrett, and Maxine Willis

The Activity Based Physics High School CD was developed for use in the NSF sponsored Activity Based Physics Institutes held in the Summers of 2000 – 2003 simultaneously at Dickinson College in Carlisle, PA and the University of Oregon in Eugene, OR (NSF Grant No. ESI-9819626). The ABP Institute staff has arranged to provide 5-year licenses to individual high schools for a large collection of teaching materials. Since most of the curricular materials on the CD call for use of microcomputer-based laboratory systems (MBL's) for the collection and display of data, licenses to use this CD are being distributed by both leading vendors of MBL hardware and software: (1) Vernier Software & Hardware (Portland, OR) and (2) PASCO scientific (Roseville, CA).

This CD contains electronic files that include portions of published curricular materials adapted for high school use. These Activity Based Physics materials which were developed between 1986 and the present share a common theme. Their development has been based on the outcomes of physics education research and they use computer technology to enhance student observation and analysis of real phenomena. These materials have been drawn from:

1. **Tools for Scientific Thinking Laboratories (TST)** developed by Ronald Thornton & David Sokoloff: This includes two labs on Kinematics (TST Mechanics Labs 1 & 2); an Investigation on Simple Harmonic Motion (TST Mechanics Lab 5 Investigation 2); and four labs on Sound (TST Sound Labs 1-4).

2. **RealTime Physics Laboratory Modules (RTP)** developed by David Sokoloff, Ronald Thornton & Priscilla Laws: This includes RTP Module One (Mechanics) Labs 3-9 covering Newton’s Three Laws in One Dimension; RTP Module Two (Heat & Thermodynamics) Labs 1-6 covering heat energy transfer processes, the 1st Law of Thermodynamics, the ideal gas law and heat engines; RTP Module Three (Electric Circuits) Labs 1-5 covering DC circuit behavior with batteries, bulbs, resistors, and capacitors.

3. **Workshop Physics Activity Guide (WPAG)** developed by Priscilla Laws with contributing authors. This includes a selection of units adapted from all four modules of the college edition dealing with Newtonian Mechanics (Units 1-2, 4-7); work, energy and rotational motion (Units 10-12); radioactivity (Unit 28); and basic electrostatics (Unit 19), DC circuits (Units 22-24) and basic magnetism (Unit 27).

4. **Interactive Lecture Demonstration Series (ILD's)** being developed by David Sokoloff & Ronald Thornton. This selection includes student prediction and results sheets for topics in kinematics, Newtonian mechanics, mechanical energy, heat and thermodynamics, DC circuits, and preliminary materials on optics. Teacher Guides are available for the Mechanics ILD's but are not yet ready for other topics.

Curricular materials have been modified to render them more suitable for use in high school environments. For example in the Workshop Physics curriculum the drunk in Unit 2 has been replaced by a blindfolded student and the calculus has been replaced with algebra. In addition,
a set of experiment files have been created so that either LoggerPro or DataStudio software can be used with the curricular materials.

The HSCD also contains new curricular materials developed at Dickinson College on nuclear radiation and materials for teaching sound that have been developed by members of the Physics Education Research Group at the University of Maryland. Also included are instructor materials, experiment files for use with either the LoggerPro or DataStudio software, some QuickTime movies used in Workshop Physics that can be analyzed using VideoPoint Lite software (that we have licensed from Lenox Softworks). There is a folder full of assessment examinations and answer keys to help teachers measure improvements in student learning and attitudes. Other goodies are included. In fact the CD contains over 1000 electronic files.

**DISCLAIMER:** It took a lot more work to compile this version of the disk than we anticipated. As a consequence we know that you will probably encounter bad files, glitches and omissions. For instance, some of the early Tools for Scientific Thinking and Interactive Lecture Demonstration Microsoft Word files (for both the curriculum and Teacher Guides) were produced on the Macintosh platform without attention to the use of contemporary true type fonts (such as Times New Roman and Arial). They contain embedded drawings that mix pictorial and text elements. As a consequence these files may look especially bad when opened and printed with PC computers. We plan to fix this problem in the future. Meanwhile we have created Adobe .pdf files for many of the curricular files. They are in a folder called “Unmodifiable Print Files (.pdf)”. We suggest you use these whenever you do not plan to modify the files.

**WARNING:** You should be sure to read the full license statement included on this CD before using the materials. Because of our license agreements with John Wiley & Sons and Lenox Softworks it is important that you comply with the terms of the license.

**PRODUCT SUPPORT:** We also hope that you will have suggestions for improvement of both the curricular materials and the way the CD is formatted. If you keep us informed about the problems you encounter and they are problems we can solve, we will send you an upgrade upon request. Please address your problem reports and upgrade requests to:

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APPENDIX IV: Glossary of ABPI Terms
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**Calculator-Based Laboratory Tools (CBL):** Consists of a Texas Instruments interface and programs that allow information from electronic sensors to be transmitted to a Texas Instruments graphing calculator. Used for portable, low-cost data collection and real-time graphing.

**Interactive Lecture Demonstrations (ILD):** A learning technique in which students in a lecture class make predictions, collaborate with neighboring students to discuss their predictions, and participate in an all-class discussion to explain and evaluate predictions. Students then observe a live demonstration using microcomputer-based computer tools to display real-time graphs or capture video images. Finally they compare their computer-enhanced observations with various predictions, and attempt to re-explain in a wider context the observed phenomenon.

**Microcomputer-Based Computer Tools (MBL):** Refers to the use of computers, interfaces, and sensors to collect and record data which can then be graphed and analyzed in real time.

**RealTime Physics (RTP):** This curriculum consists of a series of laboratory guides that use MBL tools to help students develop important physics concepts while acquiring vital laboratory skills. Each guide has enough material for an entire semester of laboratory activities centered around a single area of physics.

**Spreadsheet Graphing and Modeling:** Process by which students can derive the equations that describe motion, force, and other physical phenomena.

**Tools for Scientific Thinking (TST):** This laboratory curriculum is designed for instructors who want to replace some of their traditional laboratory sessions with activities designed to teach physics concepts. MBL computer tools are an integral part of the TST curriculum.

**Workshop Physics (WP):** Refers to classes taught without lectures using guided inquiry methods from the Workshop Physics Activity Guide®. Classes usually meet for two hours. A range of computer tools are used including spreadsheets, MBL tools and digital video analysis software.

**Workshop Model:** This term usually refers to classes taught without lectures using two-hour sessions three times a week.

**Workshop Physics Tools (WPT):** A set of add-in tools designed for use with Microsoft® Excel, which enables the user to create scatter plots, and overlay graphs, and do linear and polynomial fitting of data.

**Vector Visualizer:** Interactive software that allows students to learn about vector properties and operations. It can also be used to visualize 1D, 2D and 3D representations or real events using vector representations and animations.

**Video Analysis:** The process of making digital videos and selecting locations on each frame of a digital movie sequence. Video analysis is valuable in exploring motion, electrostatic forces, and the behavior of molecules in an ideal gas.

**VideoPoint (VP):** Software that enables the users to extract data from pre-selected locations on each frame of a digitized movie sequence. The data can then be graphed and analyzed.