

To: Pat Callahan, Chair PTRAs Oversight Committee  
From: Jane & Jim Nelson  
Date: Sunday, December 20, 2015  
RE: APEX Report

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The antidotal and formal review of teacher content knowledge (see HRI report for formal review of content knowledge and participant confidence in their knowledge of physics content.) is most encouraging. Participants continually point out how much they are learning about physics. A few antidotal comments are listed below.

APEX Participants comments:

1. Excellent hands-on activities suited for high school physics. It is also helpful for physical science teachers, and can be used in middle school.
2. Great summer institute and follow-up session, thanks so much!
3. I am very grateful for this summer institute and follow-up session. It has been greatly enhanced by the various resources that I have accumulated.
4. I enjoyed and learned a lot from this summer institute and follow-up session. I feel that I am more comfortable as a teacher at my school.
5. I enjoyed the seminar a lot. The instructors are great and I learned a lot.
6. I found the summer institute and follow-up session on Kinematics and Forces very helpful. When I need answers to some questions and laboratory activities, I received both. I also like how the material was taught. Using activities, whiteboard presentations, and participant discussion/presentations. We are treated like professionals, and see great teaching modeled by the instructors.
7. Ideas were shared that I can use in my classroom. Overall, this was a very great summer institute and follow-up sessions. I look forward to attending future ones like it.
8. I have vision problems and time was modified to reflect teachers or students with learning disability. Jane spent her lunchtime helping me keep pace with others.
9. J&J Nelson are wonderful presenters and motivators. I cannot wait to take additional summer institute and follow-up session with them!
10. Thank you for providing this opportunity. Jim & Jane kept the sessions alive with their unique knowledge and teaching experience.
11. The summer institute and follow-up session are very informational.
12. This was the "Best." All of the information was and is current to our class and books. The pace was excellent. Materials were the best. Both instructors were on top of information.
13. I have written new activities in the style that were presented during the institutes and follow-up sessions, and shared them with the instructors and other participants as equal professionals.

Participants indicate they are incorporating many of the PTRAs activities into their own teaching. During the follow-up session on Fluids, one participant in Cohort 2 comment that she would be using the PTRAs Teaching about Fluids manual as part of her curriculum for AP physics. Another Cohort 2 participant volunteered that he hates professional development, but this is the best he has ever attended, and he continues to return due to the quality of the instructors and the curriculum

Two APEX participants have applied for and attended the AAPT/PTRA national leadership institute beginning in 2015. These participants will become part of the present and future leadership team in Alabama, and are being developed as future professional development presenters for the future when the APEX project has concluded. We have already scheduled them into the role as presenters for the first week of cohort 3 and the nine follow-up sessions scheduled for academic year of 2015 – 2016. Jim & Jane Nelson, the existing PTRAs leaders, will work side by side with these new PTRAs to assist them in developing their leaderships skills.

As the physics content level increases within a topic the participants are asking more and more sophisticated questions, indicating they are expanding their knowledge base. The institute's atmosphere is comfortable enough so that participants will indicate when they have had a new understanding or insight as well as willingness to ask questions. During group discussions participants are learning to help each other find content understanding and develop their own classroom questioning techniques. The institute leaders model how to address naive ideas and move the learning to a full conceptual and formal understanding. The participants are also learning to make sure student have full understand of a topic being discussed before moving on to next topic.

Jim Nelson is the representative of the national AAPT/PTRA Professional Development Program, and serves as director for the APEX subcontract to AAPT. He works with the APEX leaders to assure the overall consistency and quality of the APEX Physics Teacher Institute, and serves as liaison between AAPT and the APEX project leadership. He is responsible for professional development schedule, equipment requests, the curriculum, and the pre and post instruction assessment instruments.

Jane Nelson is the lead PTRAs who leads the APEX Physics Teacher Institutes. She assures the quality of the APEX/AAPT/PTRA summer institute curriculum, instruction, assessment, and follow-up sessions are consistent with scientific content & knowledge, the Alabama Learning Exchange (ALEX); Content Standards in the Alabama State Course of Studies, Physics Core Curriculum, and research based instructional strategies.

<b>Description of Activities in 2014- 2015</b>
We developed Projectile Motion Supplement and used it to provided professional development on Projectile Motion for Cohort 1 – November 2014. This supplement will be used for Cohort 2 and 3 during future follow-up sessions.
We developed Thermal Physics Supplement and used it to provided professional development on Thermal Physics for Cohort 2 – January 2015. This supplement will be used for Cohort 2 and 3 during future follow-up sessions.
We developed Physics of Fluids Supplement and used it to provided professional development on Physics of Fluids for Cohort 2 – March 2015. This supplement will be used for Cohort 2 and 3 during future follow-up sessions.
We developed Electric Fields and Potential Supplement and used it to provided professional development on Electric Fields and Potential for Cohort 1 – November 7-8, 2014. This supplement will be used for Cohort 2 and 3 during future follow-up sessions.
We developed an Electrical Engineering Supplement and will first use it to provided professional development on Electrical Engineering for Cohort 1 – February 2015. This is motivated by the NGSS and will be used for Cohort 2 and 3 during future follow-up sessions.
We developed Capacitors Supplement and used it to provided professional development on Capacitors for Cohort 1 – April 2015. This supplement will be used for Cohort 2 and 3 during future follow-up sessions.
We develop the calendar and activity schedule for three summer institutes <ul style="list-style-type: none"> <li>• Cohort 1: Waves, Use of Ripple Tanks, Geometric Optic</li> <li>• Cohort 2: Static electricity; DC Current Electricity &amp; Magnetism, and</li> <li>• Cohort 3: Kinematics, Newton’s Laws, Momentum &amp; Energy.</li> </ul> See sample schedule in attached.
We developed Physics Waves Supplement and used it to provided professional development on Physics of Waves for Cohort 1 – June 2015. This supplement will be used for Cohort 2 and 3 during future follow-up sessions.
We developed Geometric Optics Supplement and used it to provided professional development on Physics of Geometric Optics for Cohort 1 – June 2015. This supplement will be used for Cohort 2 and 3 during future follow-up sessions.
We lead Follow-up sessions and Summer Institute.
We serve on the APEX Project Advisory Board providing advising and input to the project directors.
We advised the project director on logistical issues (e.g., recruitment, summer institute and follow-up session logistics, laboratory activity requirements, follow-up sessions, establishment of communication links, establishment of sustainable professional development program for physics in Alabama, press release, participant certificates, et cetera).
We are responsible for the development and revision of the formative and summative assessment instruments used to evaluate the impact of the APEX/AAPT/PTRA Professional Development.
We serves as the contact for the special technology purchase options and free loan of instructional materials (e.g., Texas Instruments, Ranking Tasks, Tippers, Video Analysis, PASCO and Vernier).

### **Description of Activities in 2014- 2015**

The AAPT/PTRA curriculum is very materials/equipment intensive. We provide a list and source of materials and equipment needed to implement professional development. When materials or equipment are not available locally. We worked to secure loan of the needed equipment from supporting vendors.

Despite long hours the participants show increased joy of learning as evidence by participant's enthusiasm, willing to do all task assigned, helping each other, and the classroom camaraderie. The formal information on content knowledge increase and confidence levels can come from Horizon Research Inc.

Developed and/or revised ten content assessment instruments for use by Horizon Research Inc., the project external advisors.

- Cohort 1: Post Assessment on Waves, Optics & Sound
- Cohort 1: Pre Assessment on Waves, Optics & Sound
- Cohort 2: Post Assessment on Electricity
- Cohort 2: Post Assessment on Magnetism
- Cohort 2: Pre Assessment on Electricity
- Cohort 2: Pre Assessment on Magnetism
- Cohort 3: Post Assessment on Kinematics & Momentum
- Cohort 3: Post Assessment on Newton's Second Law & Energy
- Cohort 3: Pre Assessment on Kinematics & Momentum
- Cohort 3: Pre Assessment on Newton's Second Law & Energy

The attendance at the summer institutes and follow-up sessions has been outstanding. For example in 2015 Cohort 2 has 36 participants on the role. 32 participants attended and one was excused as he is undergoing chemotherapy for cancer. This is much better than typical participant retention rates.

We developed and revised several APEX/AAPT/PTRA Professional Development Supplements to assure the quality of the curriculum and instruction is consistent with the AAPT/PTRA, national standards, and Alabama state standards, and to meet the particular needs of the participants.

- Teaching about Geometric Optics
- Teaching about Sound
- Teaching about Waves in One-Dimension
- Teaching about Waves using Ripple Tanks
- Teaching about Electrostatics
- Teaching about DC Circuits
- Teaching about Kinematics
- Force Supplement
- Projectile Motion Supplement
- Fluids Supplement
- Thermal Physics Supplement
- Torque Supplement

### Challenges and Successes:

We think that the greatest challenge and success was to work with participants having a large difference in content, confidence, or conceptualization of physics concepts. That is, participants with lower content knowledge went from basic understanding to successfully solving advanced physics problems. Participants who were unsure of attending a physics institute because they were uncomfortable with both the physics content and instructional strategies specific to the teaching of physics, were delighted that they attended and left ready to change their teaching methods as well as more confidence in their physics content knowledge. Participants left ready to try out new methods, and openly expressed that they were looking forward to additional opportunities to learn more during future follow-up sessions and summer institutes. Those who were confident about the content realized that being able to verify mathematical physics equations during laboratory activities is not enough. They gained skills in how to convey the "why" behind the algebraic physics equations and problems. They showed a great deal of change in their ideas of concepts and how to convey conceptual ideas to students through an inquiry method. They learned how to ask questions of students so that the students could puzzle out their own answers, and how to let students find the mathematical relationships found in nature through the use of data that they could collect themselves with materials available in typical physics classrooms. Participants who were mathematically challenged, became proficient at graphical analysis of data, and were delighted when they were able to discover physics relationships that they had taught, but never questioned how they knew the equations were correct.

The Alabama Science in Motion (ASIM) Leaders initially wondered if the APEX/AAPT/PTRA professional development would meet their needs; however, by the conclusion of the first institute, the ASIM leaders began to work on the revision of existing ASIM laboratory activities, and how to share what they had learned with the teacher in their region.

Doing inquiry and discovery style laboratory activities in the space and layout of the room was challenging. As a result the AA&MU has devised a renovation plan to better meet the needs of such activities. See draft of room revision plans enclosed. A smart board and video camera have been added to the classroom connecting to three screen so the large number of participant can all see the presentation whiteboards that fellow participant present for discussion.

Integration of the four aspects (Physics Content Knowledge, Use on Instructional Technology, Action Research, & Instructional Strategies) of the project has been accomplished by planning sessions. The project is using elicitation activities to bring out the major components of the instructional topics. These are used by teachers to open the discussion and to identify area of content that need special attention. By using formative assessments from Innovation Inc, teachers are able to track the progress of their student on basic content being mastered. Teachers are able to use the results of the data to support their action research.

Instructional use of technology is integrated into the teacher institutes by using graphical analysis software (e.g., EXCEL, Logger Pro, etc.), Video capture, and analysis.

The logistics of identifying, procuring and organizing of the huge equipment needed for the three cohort summer institute and follow-up sessions are accomplished by identifying on ASIM specialist to be the equipment manager for each cohort. See attached a sample list of an equipment showing item, activities where item is used, possible sources, and responsibility party for procuring items.

The content and experience diversity of the participants has been a challenge that has been overcome by building a classroom culture much like a large family in which the older children help the younger children. Experience and content knowledgeable teachers help less prepared teacher, and more pedagogical prepared teachers and ASIM physics leaders share instructional strategies with others. In general this is a win-win situation that encourages sharing and questioning, and the joy of learning.

During the AAPT/PTRA component the EX, CU, and PS will be integrated along with the reflection component recommended. For example during a typically PTRAs activity the participants will do the activity much as a student, the participants will then whiteboard and share their comments from student and teacher perspective. As part of the activity the participant will whiteboard problems associated with the activity. See for example the AAPT/PTRA "Making a One-Second Timer" Activity and Teacher's Notes with the EX, CU, PS, and RT inserted. Participants will be expected to do the activity, comment on use of activity for their classroom by answering the following questions:

- Would you use this activity?
- If so what modification would you make to better meet the needs of your teaching situation?
- How will you know if the activity is successful or not?
- Would you use any of the instructional strategies presented during this activity?
- If so what modification would you make to better meet the needs of your teaching situation?
- How will you know if the instructional strategy is successful?
- Are there any parts of the activity or discussion that we need to review or clarify?
- Are there any barriers that will make it difficult for you to implement this activity and/or instructional strategies presented during this activity?

The related issue of the mathematical background (readiness) of the cohort to be chosen, is not addressed anywhere in the proposal. Sometimes this can be a stumbling block for Physics participants.

The mathematical readiness of the cohort was assumed to be minimal and the mathematics needed will be stressed as needed. During the AAPT/PTRA component there will always be at least two PTRAs so the group can be grouped to deal with differences in mathematics background. We have correlated the AAPT/PTRA activities

to the NCTM Standards (i.e., Number & Operations, Algebra, Geometry, Measurement, Data Analysis & Probability, Problem Solving, Reasoning & Proof, Communication, Connections, and Representation.)

A challenge related to the nine follow-up sessions scheduled for 2015 – 2016 is solved by having some follow-up session with two cohorts attend the same weekend. In order to accommodate this larger number of participants these follow-up sessions will be held at UAH, which has additional space. To accommodate the larger number of instructors needed, the newly PTRA certified APEX participants will assist with the instruction using the PTRA curriculum.