



Forum on Education

American Physical Society

Spring 2009 Newsletter

David G. Haase, Editor

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Disclaimer - The articles and opinion pieces found in this issue of the APS Forum on Education Newsletter are not peer refereed and represent solely the views of the authors and not necessarily the views of APS.

The Deadline for submissions for the Summer, 2009, issue of the FEd Newsletter is June 1, 2009. Materials should be sent to the Editor, Ernest Malamud (malamud@foothill.net)

From the Chair

Ernest Malamud

Spring Meetings

The FEd has organized many interesting sessions at both APS spring meetings. I urge you, if you are in Pittsburgh March 16-20 or in Denver May 2-5 to attend these sessions. See article below.

Members of the FEd Executive Committee welcome your comments and feedback on these sessions: content, usefulness to you as a listener, questions posed, attendance and anything else such as your thoughts on sessions at the 2010 APS meetings; this feedback will be invaluable for future planning.

Middle School Science -- PhysicsQuest/FED Project

Becky Thompson-Flagg, APS's new Head of Public Outreach and I have been working together to define this project. The aim is to find ways for APS members, in particular those who have expressed a strong interest in physics education by joining the FEd, to help as volunteers to improve middle school science teaching. We propose ways they can work with middle school science teachers who are using APS's PhysicsQuest kits. (see article by Becky Thompson-Flagg)

Because PhysicsQuest is a well-established and self-contained program it is an excellent way to begin a relationship between members and schools. It also means that the time commitment is variable.

These interactions can take many possible forms. A FEd member could meet with the teacher and discuss the kit. A member could help a class through e-mails and calls with teachers and students or by actually running the program at their local school. If a physicist is directly involved with the students in any way they can see what physicists are like at the same time they are learning about what physics is. A FEd member could also help arrange a school field trip to his/her place of work. This could become the beginning of a relationship with your local school.

We have begun by selecting some schools and teachers who have kits and FEd members who live or work near the school (using zip codes) and asking each if they have the time and would be

interested in making contact. We realize that there are hurdles to surmount in fostering productive relationships. Using phone calls, emails and written guidelines we will try and work our way through these challenges. FEd members are invited to contact Becky or me if they would like to participate.

Mini-grants

Mini-grants of up to \$500 are available and turnaround is fast. Examples of past mini-grants are providing a prize for an essay competition among high school students at a Section meeting or partial support for a community physics day for high school students and teachers with a guest speaker. We have also decided that grant funds may be used to purchase a small key item of equipment as long as the connection to the educational outreach activities are clear and that the grant is to an institution or organization to ensure continued use. With all mini-grants we request a short news item and photos for the FEd newsletter.

Summer Newsletter

In the FEd Summer 2008 Newsletter, Larry Woolf tried an experiment. He obtained copies of all the Spring invited talks (March meeting in New Orleans and April meeting in St. Louis), posted them to a web page, and in the newsletter provided brief description of those talks and links to them. It appears (unless someone volunteers to be an editor or co-editor – see below) that I will be editing the Summer 2009 newsletter. Do members feel that we should do the same thing again? It is a considerable amount work but I'm happy to undertake it if it is useful. Let me know!

Newsletter Editors needed!

Here is a brief "job description" for a FEd newsletter editor. There are 3 issues per year and historically we have had 3 editors, one per issue. So for an individual it is a once/year task. The process needs to begin well in advance of the deadlines. We try and have the Fall issue completed by the end of the calendar year (October 1 submission deadline), the Spring issue out in

time for copies to be available at the Spring APS meetings (in 2010 the first of these, the so-called April meeting, will be in February so that impacts the newsletter schedule), and the Summer issue in time for copies to be available at the AAPT summer meeting. The Editor either solely or in consultation with members of the FEd Executive Committee decides if there will be a theme, and if so what the theme will be. Then the editor makes a list of articles and authors, contacts and solicits the submissions, and as they come in edits them. In most cases the editing is "light." But there are usually some articles that need significant revision or shortening to improve them. Each editor has an individual style – mine is to encourage graphical content (graphs, photographs, even animations and in the future possible YouTube clips) since the newsletter is on-line and I feel one should take advantage of the opportunities the technology

offers. But that is up to the individual editor. As in any volunteer organization we welcome new blood to participate in FEd activities. Right now a particular need is for newsletter editors. If you think this is something you would enjoy doing, let me know.

Optimism for the future

With the appointment of prominent scientists to top government positions in President Obama's Science Team, I am optimistic that we will see increased emphasis and support for improving physics and physical science education at all levels.

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Appointment of Editorial Board for the Forum on Education

FEd Chair, Ernie Malamud, has appointed a newsletter editorial board of Wolfgang Christian (Davidson College), Ramon Lopez (University of Texas at Arlington) and Peggy Norris (LBNL). The charge to the Editorial Board comes from a recent policy adopted by the APS Council:

APS encourages all of its units to provide newsletters to their members. Many of these newsletters contain only news about the unit's activities; others contain articles and opinion pieces. Today with electronic transmission, it is very easy for bloggers and others to pick up items from these newsletters and present them as the policy or opinion of APS. In order to prevent this, each paper and pdf version of the newsletter must contain a clear statement that the articles and opinion pieces are not peer refereed and represent solely the views of the authors and not necessarily the views of APS. In the case of online newsletters available in html format, each individual article or opinion piece must have this disclaimer clearly visible as part of the posting.

APS also requests that each unit that regularly includes opinion pieces in its newsletter appoint an editorial board that oversees the work of the editors. This board should have the authority to recommend the discontinuation of one or more of the newsletter editors if the editors do not abide by this policy or if the editor shows other behavior that the board finds unacceptable. The unit's executive committee will then make the final decision on this matter.

Note that the Review Board does NOT pre-approve the newsletters. Their charge is to read the newsletters and "blow the whistle" if they feel the need. In addition they have been asked to submit a short report to the FEd Executive Committee at our annual meeting.

Attend the FEd Sessions at the 2009 March and April APS Meetings!

Peter Collings and a large program committee have assembled interesting and important education sessions for the March Meeting in Pittsburgh, and the April Meeting in Denver. Take a break from the endless research sessions and update your understanding of issues and trends in all types of physics education.

The Pittsburgh meeting will include a Sunday Workshop on Integrating Computation into Upper Level Physics Courses, and invited sessions on Computational Physics, the Physics Doubling Initiative, Preparing Students for Careers in Industry, Partnerships with Science Centers, and Physics Demonstrations for Outreach. The Focus sessions will describe New Faculty Workshops, Computational Physics and REU programs.

The Denver Meeting will include an Excellence in Physics Education Award session and invited sessions on Teaching About Energy, Physics on the Road, Introductory Physics for Pre-Health and Biological Science Students, and Teaching Physics and the Arts. The Focus sessions will describe the Professional Preparation of Teachers of Physics and Adopting PER-Based Teaching Methods and Materials.

Election of New FEd Officers and Members of the Executive Committee

We are pleased to announce the results of the recent election of FEd Officers and Executive Committee members. Chandralekah Singh of the University of Pittsburgh has been elected as Vice-Chair of the Forum. Laird Kramer of Florida International University was elected as APS Member-at-Large of the Executive Committee and Amber Stuver of Caltech/LIGO was elected as APS/AAPT Member-at-Large.

We thank all of the candidates for their willingness to stand for the election. They included Steve Turley of Brigham Young University, Keith Sturgess of the College of St. Rose, Brad Ambrose of Grand Valley State, Seyfollah Maleki of Union College and John Potts 3M (retired). The new officers will take their posts at the end of the FEd business meeting at the APS Denver meeting.

In January, Gay Stewart of the University of Arkansas began her term as the APS Councillor from the FEd. We thank Pete Zimmerman for his service in representing the FEd on the APS Council for the last four years. In June, Lila Adair, the Past President of the AAPT began her term as the AAPT Representative, replacing Harvey Leff.

2009 Excellence in Physics Education Award

At the Denver meeting the 2009 APS Excellence in Physics Education Award will be presented to David Maloney (left photo) of Indiana Purdue Fort Wayne, Tom O'Kuma (middle) of Lee College and Curtis



Hieggelke (right) of Joliet Junior College. The Award is made *"For leadership in introducing physicists in two-year colleges to new instructional methods, in developing new materials based on physics education research, and in fostering faculty networking, particularly in two-year colleges."* There will be a special invited paper session at the Denver meeting in recognition of this Award.

The Excellence in Physics Education Award was instituted through the efforts of members of the APS Forum on Education. This is the third time the award has been presented. The nomination and selection process for the Award is described at <http://www.aps.org/programs/honors/awards/education.cfm> The deadline for submission of nominations for the 2010 prize is July 1, 2009.

New Fellows of the American Physical Society nominated from the Forum on Education

In November, two APS members were named Fellows of the APS nominated from the Forum on Education. John Belcher (left photo) of the Massachusetts Institute of Technology, was cited: *For developing 3D electromagnetic field visualization tools and for the creation and large-scale implementation of a studio-based, active learning version of introductory physics, TEAL.*

Stephen C. McGuire (right photo) of Southern University and A&M College, was cited: *For his leadership in exploring new ways for research physicists, traditional educators and museum professionals to work together to engage students and the public, particularly under-represented groups, in the excitement of physics.*



We congratulate the new Fellows and thank them for their contributions to Physics Education.

The deadline for nominations for 2009 Fellows is April 1, 2009. Information about the nomination process is found at <http://www.aps.org/programs/honors/fellowships/nominations.cfm>.

Letter to the Editor

I enjoyed Marty Alderman's article in the fall 2008 newsletter. I feel that mentoring is an important factor in retaining teachers. I prepared a talk for the joint meeting of AAAS/AAPT in Chicago "Social Networking for New and Cross-over Physics Teachers". I will be part of a panel How Educational Technologies Can Reach New and Cross-Over Teachers Who Also Teach Physics.

In preparing for my talk, I found the TappedIn system and set up a group for physics teachers. This will enable meetings using a chat room. I ran my idea by Marty and he would like to take the idea even further using Skype and video cameras. Here is the information about TappedIn. It has been around since 1997 and was originally funded by NSF. It is now run by SRI International with financial help from NSF and Sun Microsystems. SRI International was founded as Stanford Research Institute in 1946 by the trustees of Stanford University, became independent of the university in 1970 and changed the name in 1977.

TappedIn offers chat rooms for educators. There are roughly 5,000 members and over 700 special interest groups. I have joined two groups, science materials for K-12 and Collaboration. I have set up a group for physics teachers. In addition to the chat room, there are links to useful materials.

Patricia T. Viele (<mailto:ptv1@cornell.edu>), Physics & Astronomy Librarian, Cornell University

2008 Conference on K-12 Outreach Proceedings Available Online

The Proceedings of the 2008 Conference on K-12 Outreach from University Science Departments are available online at www.science-house.org/conf/ This was the seventh in a series sponsored by the Burroughs Wellcome Fund and The Science House at NC State University. The Conferences have covered the many ways that STEM professionals, and science research centers can support K-12 science and mathematics education. The 2008 Proceedings includes essays by Diandra Leslie-Pelecky, Marllin Simon and David Haase, APS members all.

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Thoughts on Chairmanship of the American Physical Society Committee on Education

Michael Marder

David Haase has asked me to describe the job of the Chair of the American Physical Society Committee on Education. I have just completed two one-year terms. The second term was thanks to my wife, who needed medical treatment the day before the last meeting of my first term. I was unable to go, and the committee took advantage of the empty chair's seat to elect me again.

The mechanics of the job are simple and can be described in one sentence. They consist in preparing meeting agendas, attending and chairing meetings in person and by phone, reviewing minutes, reviewing requests for APS signatures for education-related lobbying efforts, and making recommendations for a prize committee. There is not much more to say about the mechanics of chairmanship, even if there are some mildly amusing stories, one of which involved an ice storm in Washington and had me saying to a cab driver at 1 am, "Please take me to the [nonrefundable room I just booked at the] Cleveland Airport Hyatt" to which he replied, "You do realize you're in Cincinnati, don't you?"

On the other hand, the point of being chair is more interesting to think about. The education landscape in physics is complicated, mainly because current societal pressure to improve physics instruction in high schools is intense, but most physicists stick to the optimistic view, largely borne out, that if they can just keep from volunteering at just the right moment, someone else will deal with the problem. This combination of intense social pressure and intense community ambivalence has led over time to a large variety of organizations and committees.

Ambivalence about education has a long history in American physics, and in 1930 led to the creation of the AAPT, mainly because the APS felt then little concern for the improvement of undergraduate physics instruction. However, creation of the AAPT seems not to have been sufficient to remove pressure from the APS to improve education. The Forum on Education, which readers of this newsletter will all know is

one response to the continued pressure, and the Committee on Education of the APS is another.

The theory of the Committee on Education is that it will come up with policy statements and policy initiatives for the APS, and APS staff will help implement them. So, giving an example of a policy statement, if a science advocacy group in Washington is urging Congress to allocate more funds for high school laboratory equipment, they might seek a letter of support from the APS, and the APS can turn to the Committee on Education (sometimes just the Chair if the turnaround time is short) for a recommendation whether or not to sign on. As most physicists might expect by analogy with their experience in research, the experimental reality of the committee does not correspond especially well to the theory. The APS staff concerned with education can devote their full-time jobs to thinking about what they think should happen and making it a reality, while the committee members are all volunteers with three-year terms and full-time jobs elsewhere. In fact there are two different clusters of APS staff with education portfolios. One of them, under Rebecca Thompson-Flagg is concerned with Outreach and interacts rather little with the Committee on Education, while the other under Ted Hodapp, Director of Education and Diversity, communicates with the Committee on Education on a weekly basis.

Over the time I have been chair, there have been two principal activities associated with the Committee on Education. The first of these was PhysTEC/PTEC. PhysTEC is a program to increase the number of high school physics teachers coming out of 12 specific universities. It is funded mainly by the NSF with additional support from the APS. PTEC is a broader alliance of over 100 universities that have expressed support for the goal of preparing more teachers. The main accomplishments of the past two years have been to hire an additional permanent APS staff member to assist with PhysTEC, Monica Plisch; she in turn

was largely responsible for the second main accomplishment, which was acquisition of a \$750,000 NSF Noyce grant to provide scholarship support to future physics teachers at PhysTEC sites.

The second main activity was promotion of the APS Doubling Initiative, which has the goal of doubling the number of physics majors at US universities within the next 5 – 10 years, mainly so as to prepare more physics teachers. This initiative had many components, but it has not gone very far, except that physics enrollment is slowly increasing at about the right rate for reasons that probably have little to do with the APS initiative. A part of this initiative I hoped to see go forward was some way of helping improve science and mathematics instruction in middle schools, where I believe the US loses almost irrevocably most potential physicists from under-represented groups. The time for such an effort was not right. We could not come up with an action more specific than organization of a workshop, and even the workshop eventually felt like too unfamiliar territory for us to commit to organizing it.

Dwelling on unrealized hopes sets the wrong tone for a close. Commitment of the APS to improvement of education is slowly but demonstrably increasing. More permanent APS staff work on it than ever before. More and more members of the APS believe that education is among the most important charges of the physics community, and some, including very prominent ones, believe it is the single most important charge. The Chair of the Committee on Education is invited to attend meetings of the APS Physics Policy Committee, and education issues arise very frequently in discussions of the full APS leadership. Providing the US with enough physics teachers is a race against time, and we are far behind, but most of the physics community is starting to run.

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Revising Florida's K-12 Science Standards

Paul Cottle

The American educational standards movement – now about fifteen years old – has provided the intellectual foundation for reforms in the nation's K-12 schools. However, science has posed a particularly difficult challenge for the standards movement. The first generation science standards adopted by many states in the 1990's were terribly flawed in that they were simply enormous collections of facts. Science teachers were forced to race through textbooks and worksheets. Only lip service was paid to the notion that students would gain a deep understanding of any of the big ideas in science or an appreciation for what science is and how it is done. The shortcomings of the states' science standards were highlighted by comparisons like TIMSS (Trends in International Mathematics and Science Study), which showed U.S. students being outperformed by students from Singapore and Denmark. A comparison between the first

generation science standards from my home state of Florida (implemented in 1996) and those from Singapore and Denmark reveals that the lists of "benchmarks" from these two nations are much shorter than in Florida's 1996 standards. This allowed teachers from Singapore and Denmark to focus on inquiry-driven lessons that build understanding instead of requiring mass memorization of facts.

Many states are now revising their science standards. In general, these revisions seek to emulate nations and states that are more successful in science education by implementing fewer topics that can be addressed in greater depth. The committees making these revisions focus both on the research on how children learn science best and on the imperative to prepare students for college-level work.

Florida completed the revision process in 2008, approving new standards that will be tested on the Florida Comprehensive Assessment Test – the state’s high-stakes test - in spring 2012. Of the 61 members of the committee that produced the draft standards, four were professors in the Florida State University Physics Department (Hon Kie Ng, Harrison Prosper, Horst Wahl and myself). The Florida Department of Education (FDOE) asked institutions in the state’s university system to recommend faculty members – both from the Colleges of Education and the “content” (science) departments. Thomas Jordan, coordinator of the QuarkNet program at the University of Florida, was on the committee as well. Interestingly enough, the FDOE staff member who managed the committee, Lance King, had earned a bachelor’s degree in physics from FSU, had taught high school physics and had managed the FSU Physics Department’s outreach programs.

Three of the FSU physicists served on the subcommittee for physical science standards for the high school grades (9-12). They were joined by high school teachers in physics and chemistry and faculty in chemistry from 2-year and 4-year schools. University physics faculties are crucial to the standards process: they are the experts on the field of physics, they are often familiar with the results of physics education research, and they understand what is necessary to be prepared for college work.

I chose to join the subcommittee working on lower grades (K-8) physical science standards because of my experiences teaching pre-service elementary teachers at FSU. This subcommittee included teachers with extended experiences in the classroom and with administration at the school-district level. One of the members, a teacher at an Orlando elementary school, had been named 2008 Florida Department of Education/Macy’s Teacher of the Year.

The subcommittee members were encouraged that a science professor from a research university would be interested in their work. One of their dreams for their students is that they earn Ph.D.’s in science and become successful researchers and university-level educators. Most of the teachers and administrators I have worked with over the

years have welcomed and enjoyed my collaboration.

My experience with the Physics by Inquiry curriculum (from Lillian McDermott and the University of Washington) in teaching pre-service elementary teachers and my familiarity with the Physics Education Research literature provided a useful research base for decisions being made regarding benchmarks. On this last point, it must be made clear that I am simply an educator who is aware of the research performed by my colleagues in the Physics Education Research community. Nevertheless, I usually carried a copy of Volume 1 of Physics by Inquiry to the meetings. The folks I worked with respected the research represented in Physics by Inquiry and other work done by the PER community, even though that community’s work is not generally used as a source in the K-12 community. Physics by Inquiry, a college level curriculum, was a useful reference point in the discussions. For instance, some of middle school benchmarks listed in the 1996 standards would have been too challenging for a basic college class.

My presence provided some scientific clout when our subcommittee negotiated with the 9-12 physical science group and the K-8 groups from the life and earth/space sciences. These negotiations became quite gritty at times. For example, the life scientists and chemists had somewhat unrealistic ideas of what middle school students should understand regarding atomic and molecular structure. Having a physics professor point this out was helpful in keeping the discussions constructive.

Scientists often assume that educators and K-12 administrators are less interested in scientific accuracy and integrity than working scientists because of the various demands on public school systems. The educators and administrators with whom I worked on the standards (and on other collaborative projects on which I have worked for years) have been at least as concerned with scientific accuracy and integrity as I am. Without scientific accuracy, there is no science education. In addition, the K-12 educators and administrators I’ve worked with have used the knowledge base on the science of learning in their decision-making. All in all, these K-12 educators have been focused on science.

In the end, the standards approved by the Florida Board of Education on February 19, 2008, were a significant improvement over the first generation standards implemented in 1996. There are fewer topics and a focus on a small number of “big ideas”. An example of a “big idea” in physical science is “Big Idea 10: Forms of Energy”. It states:

- a) Energy is involved in all physical processes and is a unifying concept in many areas of science; and,
- b) Energy exists in many forms and has the ability to do work or cause a change.

So in this respect, the standards revision process was a success.

Nevertheless, the members of standards committee recognized that excellent standards alone are insufficient to transform a state’s educational system to provide a world-class education in science. On February 27, eight days after the Florida Board of Education approved the new standards, 39 of the standards committee members sent a letter to Florida Education Commissioner Eric J. Smith calling for a substantial financial commitment to improving science education in Florida. The proposed commitment included \$100 million per year for science teacher professional development, an amount comparable to that spent in Florida’s successful effort to improve achievement in reading. As of this writing, the state has mustered only \$5 million of federal professional development money to support the implementation of the new standards, and the state’s budget is in free fall.

By now, some readers will have correctly noted that I have avoided the elephant in the living room – the debate over evolution education. The evolution debate consumed an enormous amount of energy and focus. The standards committee members took to calling evolution “the e-word.” In a perfect world, the “e-word” would have been “excellence” instead. The battleground was “Big Idea 15: Diversity and Evolution of Living Organisms”, which reads (after a slight revision by the Florida Board of Education during the clamorous meeting where the standards were approved):

- a) The scientific theory of evolution is the organizing principle of life science.
- b) The scientific theory of evolution is supported by multiple forms of evidence.
- c) Natural Selection is a primary mechanism leading to change over time in organisms.

The battle over evolution in Florida has been well documented in the media, including the Orlando Sentinel, the St. Petersburg Times and the New York Times, so I will not go into details here. The battle continued on to the 2008 session of the Florida Legislature after the approval of the State Board, and it will no doubt continue into 2009. It has spread to other states as well, including Kansas, Texas and Louisiana, where the governor (a Rhodes Scholar who holds a bachelor’s degree in biology from Brown University) signed the anti-evolution education “Academic Freedom Act” into law.

Physicists should care about the evolution debate because it speaks to the integrity of the science classroom as a place where scientific observations are explained exclusively in terms of the laws of nature. I participated in this debate through speaking to the Florida Board of Education February 19 meeting where the standards were approved and to a committee of the Florida Senate considering the Academic Freedom Act. I also wrote several letters to the editor and op-ed pieces on the subject. Such opportunities are open to everyone. I have also been fortunate to associate with the members of the Florida Citizens for Science, a group formed to defend evolution education in our state. The physics community has much to learn from their passion and commitment.

Most physicists do not realize that our field is in the vanguard of science education reform. This circumstance provides both an opportunity and a responsibility to lead, and we must embrace both.

Paul Cottle
(<mailto:cottle@nuclmar.physics.fsu.edu>) is a Professor of Physics at Florida State University and the Chair-Elect of the Southeastern Section of the APS. In 2002 SESAPS awarded him the George Pegram Medal for Excellence in Education.

Support for High School Physics Teachers through the Alabama Science in Motion Program

Paul Helminger

Introduction

Since 1994, Alabama has funded a statewide high school science initiative in physics, chemistry, and biology which is centered on a network of traveling vans. The *Alabama Science in Motion (ASIM)* program provides public high school students with laboratory experiences with modern instrumentation and offers teachers professional development opportunities through workshops and mentoring links with university faculty. Three *ASIM* vans dedicated to physics, chemistry, and biology operate in each of the 11 teacher in-service regions, and these are administered through state universities in that region. Each van is driven by a certified science teacher who serves as the Discipline Specialist. Typically, the vans are equipped with more than \$100K of laboratory instrumentation and serve 30 regional high school classes. The *ASIM* program became the high school science component of the *Alabama Math and Science Initiative (AMSTI)* in 2000. *AMSTI* is a comprehensive statewide program for improving math and science education in Alabama for students in grades K-12.

A project director is responsible for the administration of the *ASIM* program at each site. The project directors at most *ASIM* sites are affiliated with university in-service centers or with dean's offices. It is interesting that the project directors directly affiliated with university science departments (at Alabama-Birmingham, Alabama-Huntsville, Auburn, and South Alabama) are all physics faculty members. This is a clear indication of the willingness of the university physics community to get involved with worthwhile educational outreach projects. In this article I will discuss the ways that high school physics teachers benefit from being a part of the *ASIM* program.

The Current Classroom Situation

The introduction section of the 2007-08 Report to the Alabama Legislature on *ASIM* provides a summary of the science education situation in our state:

Science is a discipline rooted in experimentation. Learning science requires an understanding of the scientific method that is acquired through "hands-on," "minds-on" laboratory activity. Equipment, knowledge of content, knowledge of teaching strategies, and preparation time are essential elements of effective science teaching.

Unfortunately, all four are frequently lacking in the science classrooms of Alabama. Few schools have the equipment and supplies needed to run an effective laboratory program. Like most teachers, science teachers teach multiple subjects during the day. Running a laboratory component for each of these different subjects requires additional preparation time that most teachers do not have. It is difficult to conduct laboratory activities when equipment, knowledge, and time are inadequate.

Another difficulty is that while the majority of high school physics, chemistry, and biology teachers in Alabama are certified in science education, many are teaching out of their specific field of training. This is particularly true in physics. The *ASIM* program provides services that offer a remedy to the situation. The program also encourages active cooperation among the secondary science teachers, the university science education faculty, and the natural sciences faculty to improve the overall quality of science education in each region of the state.

Addressing Physics Classroom Needs

The Physics Specialist at each site is the point of contact with the *ASIM* high school physics teachers. The Physics Specialist usually works closely with a physics faculty coordinator at the site who helps with concepts, developing laboratory experiments, and teacher workshops. The Discipline Specialists across Alabama meet several times a year to address a variety of program issues. As a result of these meetings, two levels of laboratory experiments (Level I and Level II) with approximately 20 experiments at each level have been identified. These core laboratories, covering the standard topics in the physics curriculum, are offered at each site along with a small number of

other experiments. The equipment for the experiments includes laptop computers, Pasco interface units with sensors, carts and tracks, electricity breadboard kits, projectile launchers, rotational motion apparatus, and optics kits.

A physics teacher joining *ASIM* is required to attend 10 days of Summer Institute training in the Level I labs. This acquaints the teacher with the equipment and the physics fundamentals behind the most important core experiments. Teachers are paid a stipend to attend summer workshops. At the workshops, teachers form groups to perform the experiments and to discuss how best to teach both the background material and the laboratories. The experiments include a separate “teacher-notes” section explaining the principles behind the lab. At the high school, the Physics Specialist may completely teach the experiment, assist the classroom teacher with instruction, or drop off the equipment for the teacher to use in an upcoming class.

An additional 10 days of Summer Institute training in the Level II experiments are also required. The Level II experiments are typically more difficult and are not as frequently used. The more experienced *ASIM* teachers (Level III teachers) as well as university physics faculty members are often called upon to assist with Level I and Level II workshops. Limited workshop training is also offered to *ASIM* teachers during the school year. The topics for these workshops will vary depending on the site. They may include discussion of new or lesser used labs, special topics in physics, teaching methods, and lecture demonstrations. Level III teachers are required to attend at least one day of *ASIM* workshops each year.

Final Comments

The fact that nearly 70% of the physics teachers in the public high schools of Alabama voluntarily participate in *ASIM* attests to the effectiveness of the program. In preparation for writing this article, I asked physics teachers for comments about *ASIM*. I received a number of very positive responses and will conclude with one teacher’s comments:

I am in my second year of teaching, and first year of teaching physics. I also have 5 different other classes to teach that I have no experience teaching. I am highly qualified in biology, so physics is not my strong point. I am at a very rural school with very little supplies. ASIM has allowed me to gain content knowledge, get advice from experienced physics teachers, gain access to lab supplies, and receive the much needed support and encouragement I need with six new preps. The program also allows me to spend my already limited classroom funds on other things since I have access to lab supplies from ASIM. I wish that my education classes in college would have been designed more like the ASIM workshops. They are so beneficial and informative since you cover content and methods of teaching. My students and I have both thoroughly enjoyed ASIM and will use it very frequently in the upcoming years.

Obviously, there is a very great need for outreach from the university physics community to high school physics teachers.

Paul Helminger is Professor of Physics at the University of South Alabama and Project Director for that ASIM site. For more information on AMSTI/ASIM you may contact him at <mailto:phelminger@jaguar1.usouthal.edu>, or visit <http://www.amsti.org>.

Physics Faculty And Educational Researchers: Partners In Reform

Charles Henderson and Melissa H. Dancy

Introduction

In recent decades, physics education research (PER) has developed substantial knowledge about the teaching and learning of physics as well as research-proven instructional strategies and materials based on this knowledge. Yet, the majority of university-level instruction remains traditional. It is common for the lack of wide-scale reform to be attributed to faculty characteristics (e.g., faculty are interested in research, not teaching; or faculty believe that they are effective teachers and, thus, see no reason to change). While these sentiments are not completely unfounded, we were dissatisfied with the “it’s the faculty” explanation of slow reform.

To begin to better understand this problem from a different perspective, we conducted exploratory interviews with a sample of five senior physics faculty who represent highly likely users of educational research. These faculty were highly interested in teaching, motivated to change, and familiar with many of the new teaching ideas. This purposeful sample (as opposed, for example, to a random sample) of faculty was chosen because identifying and reducing the barriers to reform for those faculty most likely to change seemed to us like an important aspect of any reform agenda.

These interviews identified two significant types of barriers: divergent expectations between faculty and educational researchers and situational constraints. This article will focus on the first. Unlike situational barriers which are built into the structure of the educational system and, thus, likely very difficult to change, the barrier of divergent expectations can be changed when both groups decide to change their interactions with one-another. More complete results of this study can be found in references 1-3.

As will become apparent later in this article, one of the important features of the way that the PER community currently interacts with other physics faculty is that the interaction is often perceived by

both parties to be a one-way transmission of information. In this mode of interacting, the PER community is seen as developing knowledge about effective teaching and then using various methods, such as talks, articles, books, published instructional materials, etc., to transmit this information to other physics faculty.

Divergent Expectations

As expected, all of the faculty we interviewed believed that they faced instructional problems that could potentially be improved via changes in their instructional practices. They were also aware of research-based instructional innovations that might be useful for solving the problems. For example, they were all able to describe the names and basic practices involved with several instructional strategies based on physics education research.

Also, as expected, they all reported making various changes in their instructional practices throughout their teaching careers. When making these instructional changes, however, most of the research-based resources and knowledge were not used. Why would these faculty not make use of these PER results that are readily available? During the interviews it became apparent that these faculty had problems with some of the results of education research, and also with the way in which research practitioners disseminated these results. Many of these faculty expressed great frustration with this situation. In the following we describe three themes that emerged from the interviews related to the interactions between researchers and the instructors.

Theme I. PER is perceived as dogmatic

The interviewed faculty tended to see educational researchers as not really interested in them or their students, but rather as promoting a particular curriculum. Faculty also criticized educational researchers as promoting their instructional package or technique with the expectation that it

will work well in any environment, even ones quite different from the one in which it was developed.

Theme II: Perception that PER Says I'm a Bad Teacher

The PER community has put much effort into discrediting traditional transmissionist instructional approaches. For example, it is common for PER researchers to compare research-based instructional innovations to more traditional lecture-based approaches, with the innovation being shown to be superior. The faculty we interviewed described emotional reactions to this message. They saw educational researchers as insinuating that they are bad teachers: "The first word out of their [a typical PER presenter] mouth is you're not doing things right."

These faculty care about their students and an important part of their identity is their role as a teacher. It is difficult when they perceive that the PER community is telling them that they've been doing it all wrong and perhaps even causing harm to their students. Not unexpectedly, their reaction can be defensive. They want their expertise and experiences to be respected.

Theme III: Faculty Want to Be Part of the Solution

As a result of the way that these faculty perceive their interactions with educational researchers, they may not make full use of research-based findings. They recognize that research has something to offer. Yet, they feel a need to be part of the solution. As one interviewee said "I've spent my life doing this [teaching] and part of my teaching is in fact to be aware of all of the things that are going on [in educational research], but I want it to be useful and meaningful to that discourse."

What most of the instructors appear to describe as a desirable situation is some degree of cooperation with PER researchers where the PER researcher will work with them to decide on instructional practices that fit their individual situations. This would be based on the instructors' knowledge,

skills, preferences, and teaching situation as well as on the available research knowledge about teaching and learning.

Conclusion

We have identified a potentially widespread mismatch between the expectations of educational researchers and traditional faculty that may be an important barrier to the spread of reformed instructional practices. This mismatch in expectations often leads to distrust and lack of cooperation between the two groups. Reformed instruction is necessarily instruction that in some way challenges the status quo and making the change means overcoming both personal and situational resistance. The results of this study suggest that the partnership model of reform offers a greater likelihood of success than the currently dominant transmission model.

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APS PhysicsQuest

Rebecca Thompson-Flagg

The middle school years are critical in sparking a life long interest in physics yet there are few programs dedicated to this group of students. These “tweens” can be hard to reach. In 2005 APS celebrated the 100th anniversary of Einstein’s “Miracle Year” with the World Year of Physics. As part of this celebration an outreach project targeted specifically at the “tween” audience was born. This project, called “PhysicsQuest,” was so successful and filled such a great need that it was continued and is now in its 4th cycle. The primary goal of the project is to give kids a positive experience with physics. At this point in their education many students may not be clear about what physics is except that people, including their teacher, see it as “scary.” What a better way to overcome this fear in the “tweens” then to make their first understanding of physics a positive one.

The PhysicsQuest project sends out free kits containing all the equipment need for for fun physics experiments to over 11,000 classrooms around the country. As the students perform the activities they are helping to solve a mystery about a famous physicists. The kit includes an instruction manual that has information on the history of the year’s chosen physicist and the mystery being solved, open-ended instructions for the students and background information for teachers. This allows all teachers, even those that might not feel comfortable with physics, to be able to teach the information. In the past students have helped Einstein find his buried treasure, decoded a secret message sent by Ben Franklin, helped Marie Curie find her next class and this year the students are helping Nikola Tesla win the “war of the currents.” The idea of building a story around the activities serves two purposes. First it helps to keep the kids engaged throughout the whole set of activities. They have to complete all four to fully solve the mystery. Secondly it gives students the chance to learn a bit of physics history. Many teachers want to employ an interdisciplinary approach to learning and by adding a history component to the program it allows them to do this. Though solving the mystery is a reward in

itself, APS gives a little added bonus. If classes successfully complete all four activities they can enter their answers online and if their answers are correct, they are entered to win iPods as well as gift certificates for classroom science supplies. Every class that enters answers online, regardless of whether or not their answers are correct, receives a certificate of participation.

The program has been a huge success. We began by sending out kits to 5,000 classrooms across the country and the program has now expanded to reach over 11,000 classrooms. Over 50% of teachers participating this year have participated in a previous year. Last year 100% of teachers surveyed rated their experience with PhysicsQuest as a positive one. The goal of the project is to give kids an exciting and positive experience with physics and these surveys suggest we are doing that job well. As with any project of this type we hope to reach the schools that are most in need. Last year 40% of the participating teachers surveyed were teaching in a school that received some sort of Title 1 funding. We also have a large amount of home schoolers participating in PhysicsQuest.

This year is the 4th iteration of PhysicsQuest. After 3 years of similarly styled books, this year’s manual capitalizes on the success of this summer’s comic book blockbusters and contains a comic with Nikola Tesla cast in the role of the super hero. The students help Tesla battle Edison in the War of the Currents by completing the four activities and hunting through the comic book pages to find pigeons that have stolen Tesla’s tools. This year’s kits have one activity that focused on index of refraction and three activities that explore electromagnetism. Many students have a difficult time understanding the topic of electromagnetism and teachers often have a hard time finding simple explanations and experiments so this kit is designed to fill that need. We have found through our surveys that teachers may begin the Quest but due to various reasons will not complete all of the activities. This year’s manual is constructed so

that the comic book pages are broken up with a few pages before each activity. We are hoping that the desire to finish the comic will drive them to attempt all the activities. We will also distribute the comic on its own at both the NSTA and AAPT meetings this year.

To learn more about the PhysicsQuest program and to download past manuals please visit www.physicscentral.com/physicsquest . If you would like more information about how you can help please e-mail physicsquest@aps.org.

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Voices from the Classroom: A Journey There and Back Again

Drew Isola

This is my second year back in the classroom after a two-year absence spent serving as a Teacher-in-Residence (TIR) for the PhysTEC Project (www.phystec.org). I've been a high school physics and math teacher since 1982 and returning to the classroom, after spending two years on campus working to improve physics teacher preparation, was another first, in a long line of career firsts. My first year of teaching, watching my first class graduate, my first year teaching 8th grade, teaching AP classes for the first time, the first time I watched a former student graduate college, the first time I attended the funeral of a former student.

It was almost four years ago now that the PhysTEC Project leaders from Western Michigan University convinced me to take a leave of absence and come on board as the TIR (<http://www.phystec.org/components/master-teachers/index.php>). They had tried a few years earlier to convince me when the project was just getting started, but I managed to come up with too many reasons why I couldn't step away temporarily from my classroom. But this time was different, my school district agreed to the arrangement and so my journey began. Little did I know what I was in for and how different my life would be.

Believe it or not, life as a high school teacher is a fairly isolating and somewhat secluded existence. I know that sounds difficult to believe. I mean, you are surrounded by hundreds of teenagers everyday, thrust into every aspect of their lives whether you want to or not, and are required to instill

motivation, enthusiasm and curiosity in them everyday through the intensity and brilliance of your classroom 'performance'. By and large, your whole life revolves around every detail and event that they choose to bring into the classroom. Your mind is constantly focused (before, during and after school) on what you've done, what they've learned, what they've missed, and what they still need to do before the end of the marking period. Becoming a TIR brought me out of that small worldview in ways I didn't expect, such as: finding myself in a Wal-Mart on a Wednesday morning on a school day and feeling like I was doing something wrong; eating lunch and going to the bathroom whenever I wanted; forgetting to eat lunch because the bell didn't ring.

As an experienced teacher I thought I was fairly aware of what was going on in my classroom, in my school and even with local and statewide education issues. I worked on professional development committees for my district. I helped lead local workshops for elementary teachers to help them teach some of the more difficult physics-related topics that they were required to teach. I also assisted a few local districts with curriculum alignment issues related to changes in state science standards. But once I began my TIR experience and attended national meetings to meet with people from all over the country working on the PhysTEC Project, my awareness of physics teacher preparation issues and physics education improvement projects expanded exponentially. To be honest, I had previously only been vaguely aware of organizations like AAPT, APS or even

the NSTA. I had attended a few MST A conferences here in Michigan, which I found very interesting and helpful, but never even entertained the thought of attending or being involved in a national organization. Because of PhysTEC, I've had the opportunity to attend and present at numerous national meetings the past 3 years. Something I'm sure I never would have done on my own.

Being a TIR in the PhysTEC Project is like living in a fish bowl. Everything you do must be documented and measured. At every PhysTEC site around the country every activity that is planned and every change that is implemented is discussed and analyzed before, during and after it happens. It is held up against the three guiding questions that have focused the work of the project for over seven years:

Are we producing more physics teachers?

Are we producing better prepared, high quality teachers of physics?

Are these teachers staying in the profession longer?

Basically, the PhysTEC Project is a very large, long term, social experiment in physics education and physics teacher preparation. Those of us who work (or have worked) on the project are used to being constantly asked questions about what we are doing and what impact it is having in these three main areas. So I was a little taken aback, and somewhat unprepared, when I was asked a few months ago as the lead-in to this article, "How has your participation in the PhysTEC Project impacted you personally?" I didn't have a quick answer and I had to think about it for a while.

Now being caught unawares by a question is not a normal state of affairs. As an experienced classroom teacher I am bombarded by unusual questions on a regular basis and am rarely knocked off-guard by one, "How old are you?" "Didn't you wear that shirt yesterday?" "Did you know you have gray hairs?" "Did you know that you are older than my parents?" The most recent classroom question that gave me pause came just after I was explaining for the umpteenth time that being called 'Doctor' because you have a PhD does not mean one is qualified to give medical advice. One of my louder and more outspoken students asked if having a PhD meant that I could teach

college to which I responded, "I suppose so." He quickly followed up with, "Then why would you want to teach us?" The question caught me off guard because of all its subtle implications and unspoken thoughts that obviously inspired it. I was able to quickly recover because of my many years of being put on the spot in the front of the classroom, smiled sweetly and said, "Because I am so excited everyday to be able to help you learn how to solve quadratic equations." Everyone snickered and we moved on. But the question is a good one that every teacher, no matter what level or what subject they teach, should be able to answer. Every teacher should be able to look out over their class whether it's an elementary science class, a high school physics class, or a college level modern physics class and answer the unspoken question in their students' minds, "Why would you want to teach us?"

So, how has my participation in the PhysTEC Project as a TIR impacted me personally? Well, it definitely has given me a much broader perspective on what is happening and what needs to happen to improve the teaching of physics at the national level. For example, I now get to serve on the AAPT Committee for Teacher Preparation, work on writing teams for documents to support the new statewide physics standards here in MI, and still participate in science standard alignment committees in my local school district. Much of what I have experienced these past few years has validated many of the conclusions and beliefs I have developed over the years about teaching and what new teachers need. I am heartened and encouraged by what I see and hear from colleagues at the university level who work hard on such matters. I am extremely impressed with the level of importance these colleagues attach to the input they receive from experienced classroom teachers, like myself, who are serving as TIR's past and present at PhysTEC sites around the country. TIR's and Master Teachers are treated as professionals by their university colleagues much more frequently now than was the case 10 years ago. They are looked at as a source of invaluable input and a wealth of knowledge from the world of the K-12 classroom.

Most importantly, being a TIR for those two years has impacted the way I teach. I am more cognizant than ever before of the important role that high

quality teaching plays in student achievement. I am much more focused on being aware of what it is my students are actually learning (or not learning). I am able to make much more informed choices about what are the most fundamentally important concepts of physics that students should learn and what information, topics, and end-of-chapter problems are excessive and only add to students' confusion and frustration. Lastly, my increased awareness of my students and what it

takes to help them learn has helped me do a better job of answering the question, "Why would you want to teach us?"

Drew Isola (<mailto:disola@alleganps.org>) now teaches at Allegan High School, Allegan, MI and is still active in the PhysTEC Project as a 'former TIR'.

Chemistry Education: Issues and Trends

Melanie Cooper

There is growing recognition that effective education depends upon an appreciation of how students learn, how they are motivated, and how they are assessed. This understanding has led to a growth in the number of Chemistry Education Research (CER) programs and their increased acceptance in chemistry departments – a situation analogous to that in physics. Over 30 graduate (Ph.D. MS. M.Ed.) programs in chemistry education within chemistry departments now exist. Of these, however, less than half offer a Ph.D. and only seven have more than one faculty CER researcher. Nevertheless, there appears to be an increasing recognition (as indicated by the numbers of available faculty positions) that the presence of CER within a department is a positive development.

That said, the growth of chemistry-based education research has not been without issues, often specifically related to the question, "what is it that CER faculty can and should do?" How should they be judged, in the context of other faculty seeking tenure and promotion, and indeed should CER faculty even be on the tenure-track. In response, a number of documents have been produced that offer guidelines about CER scholarship. In particular, the ACS Division of Chemistry Education commissioned a white paper on the hiring, evaluation, and promotion of chemistry-based chemical education researchers¹, and also developed a report that explicitly defines what constitutes CER scholarship². The ACS Statement on Scholarship³ provides explicit guidance on what constitutes scholarship in the chemical sciences, including scholarship in CER.

Equally important are resources designed to provide information to non-CER faculty both to inform them about the goals of CER and to assist them in incorporating research based teaching methods into their instruction^{4,5}.

While there are many reasons for a chemistry department to hire a CER specialist, all too often a major (implicit) rationale is that they will be responsible for everything related to chemistry education. Examples of such activities include: coordination of large general chemistry programs, laboratory development and oversight, curriculum development, teacher preparation, and outreach to both schools and the public at large. These are tasks that would not be expected of a "standard" chemistry researcher and they make the already difficult task of running a viable CER program difficult. If CER is important, then it should be treated as a valid research enterprise, on the same level as research into organic or physical chemistry. If not, the faculty member's departmental credibility and research viability will be negatively impacted.

Current trends in CER: It is not possible to do justice to all of the efforts in CER in this short piece. Given that there are many commonalities between CER and PER I will highlight trends that may be unique to chemistry.

Assessment: A great deal of time and attention have been devoted to the improvement of teaching and learning in the sciences; unfortunately, these efforts do not appear to have lead to significant increases in student understanding, interest, or motivation. The idea that effective reform is driven

only through objective outcomes assessment, should be self-evident; but unfortunately many scientists' beliefs about education are largely anecdotal and self-serving. A major focus of CER is to provide objective outcomes assessments; recent examples include instruments to measure metacognitive activity⁶, student expectations⁷, self-concept⁸ and attitudes⁹. Ongoing projects are aimed at developing instruments to measure problem solving skills¹⁰ and conceptual understanding.

Compared to other disciplines, the ACS Examinations Institute provides a unique source of assessment data; it produces nationally normed examinations for a large number of chemistry sub-disciplines. While most of these exams are developed by practitioners, rather than chemistry education researchers, these tests do represent what is generally deemed to be the accepted body of knowledge and appropriate level of performance in the discipline. These examinations can provide evidence that a course reform has not "dumbed down" the curriculum (a common complaint from "traditional" faculty and some students). On the other hand, because these assessments are quite traditional; they often concentrate on memory and algorithmic – rather than conceptual and transferable – understanding and skills. There are a growing number of "conceptual" exams available, however, and the Examinations Institute is developing new programs to provide researchers and instructors with access to data and resources. The goal is to enable instructors to track individual student content knowledge over their undergraduate career and to examine student performance based on the cognitive complexity of the questions.

Systematic reform: A number of NSF-funded initiatives have attempted systematic reform in chemistry over the years. Several of these programs have had some impact on the way chemistry is taught. "Peer Led Team Learning" (PLTL)¹¹, incorporates out-of-class student teams facilitated by peer (undergraduate) leaders working with scaffolded materials. PLTL has become widely accepted in part because it does not require the instructor to dramatically change the structure of their course. In contrast, "Process Oriented Guided Inquiry" (POGIL), is designed to replace the lecture approach. Based on research on

learning, POGIL¹² uses a three-phase learning cycle approach, exploration – concept invention – application, facilitated by student groups using worksheets. The effectiveness of both POGIL and PLTL strategies have yet to be measured extensively, although such assessment has been initiated.¹³

Data Driven Reform: The culmination of research into how people actually learn (cognition, pedagogy), what they need to learn (content, context), in what order concepts and skill are best introduced (learning progressions), what barriers to understanding exist (naive and instruction induced misconceptions), and how formative and summative assessments can be used to solidify understanding, collectively will eventually lead to new, more effective curricula. Chemistry - "the central science" - plays a vital role in the development of future technologies, ranging from energy capture and transformation, to the development of new materials and pharmaceuticals, and the protection of the environment. Moreover, a robust understanding of chemistry is central to the increasing molecular focus of the life sciences. Our own effort in this area, "Chemistry, Life the Universe and Everything", is an NSF-funded, research-based general chemistry course curriculum designed to develop chemical concepts in the context of the emergence and evolution of life.¹⁴

In summary, chemistry department-based CER is growing as a recognized field. We are getting to the point where there are important opportunities for fruitful dialog between CER and PER, particularly since many chemical principles rest on physical concepts and physics increasingly demands a robust understanding of chemical principles.

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The FGSA in 2008 and Prospects for the Future

Amber L. Stuver

The Forum on Graduate Student Affairs (FGSA) has had a year of continuing growth and is beginning to lay foundations to establish more collaboration with other similarly interested parties within the APS and the AAPT.

In 2008:

In 2008, the FGSA was pleased to have its first voting representative on the APS Council. This achievement recognizes the growth of our forum, which has tripled in population in the last four years to represent nearly 7.5% of the total APS membership (as of 1 January 2008). We were invited and sent representatives to the APS/AAPT sponsored conference "Graduate Education in Physics: Which Way Forward?" and submitted our own poster. We are also pleased that at the 2008 Unit Convocation, the participants advocated the institution of an official student representative position to APS units and divisions.

At the March Meeting in New Orleans, the FGSA sponsored a panel discussion on non-traditional careers for physicists (which is also an ongoing topic of interest for us: a collection of non-traditional physicist profiles is available on the

FGSA page at <http://www.aps.org/units/fgsa/careers/>) and co-sponsored a session with CSWP (Committee on the Status of Women in Physics) to discuss issues related to balancing family needs with career goals, and a panel discussion with FPS (Forum on Physics and Society) on the topic of universities affected by Hurricane Katrina and how to plan for other similar catastrophic events.

At the April Meeting in St. Louis, we sponsored another session on non-traditional careers in physics and co-sponsored a session with the FPS on equipping scientists to run for political office, and a session with the FED on preparing teaching assistants to teach.

In an effort to expand the reach and influence of the FGSA, our executive committee has also made a formal proposal to the AAPT Committee on Graduate Education in Physics to express our interest in collaboration and to attempt to open a means of communication between our two groups.

For the Future:

Along with continuing to sponsor programming at APS meetings and being a source for invited student representatives at appropriate meetings, I see many potential collaborations between the FGSA and other similarly interested parties. I must stress here that the following views are mine alone.

My motivation for establishing collaborations derives from the experiences I had at the “Graduate Education in Physics: Which Way Forward?” conference. I, along with two graduate students (I was no longer a student at the time of the meeting), represented the FGSA at this meeting mostly composed of department heads and directors of graduate studies. I was more than impressed at the willingness of the other attendees to hear and even actively seek out our opinions and student points of view. Near the end of the meeting, Kenneth Heller, Past President (2006) of the AAPT, asked who was a member of the AAPT and I was surprised that not more than a handful of participants raised their hands (of which I was not one at the time). This made me think about why I was not a member and why so few of these people who had a vested interest in physics education as a profession were not either. My conclusion was that I did not see myself as part of the ‘physics teacher’ community and I think that many of the other attendees did not either; I think that in higher education we often see ourselves as a separate entity from physics teachers in the primary and secondary levels. This is likely a self-propagating condition as graduate students are trained by other physicists in higher education who are also unlikely to be members of the AAPT - what connection would a graduate student then feel to the broader physics teacher community?

My solution to this is to actively encourage graduate student participation in the AAPT through collaboration with the FEEd and the FGSA. There is already AAPT recognition for exceptional teaching assistants but this impact is limited since few students can be recognized. I would prefer to see more programs designed to encourage and enable graduate students to lead outreach programs for students and the public. Such programs are becoming a favored component to grant proposals

and, with many faulty members already often overwhelmed with other teaching, research and administrative duties, having students take active roles in such programs would be beneficial to their PI’s research group as well. Programs could be as simple as helping a local scout group earn a science related merit badge, developing and conducting educational activities with local schools, having public events which feature interactions with graduate students and having graduate students participate in teacher professional development programs for both pre-service and in-service physics teachers. Documentation and publication (in *The Physics Teacher*, for example) of new or innovative educational methods would be not only beneficial to the graduate student’s CV but would also be an outreach deliverable for grants. Such experiences would help graduate students see themselves as a contributing part of the larger physics teaching community by having experience educating others who are outside of the Ivory Tower and having this service valued by those within the higher education community. Of course, this is not a goal achievable only by the AAPT as the FEEd can help encourage the same experiences in graduate students.

The health of the physics community is largely dependent on the relationship between physics teachers in higher education and those in the primary and secondary levels: certified physics teachers prepare students who will someday become physicists or taxpayers (who fund physics research) while higher education prepares future teachers. I hope that a collaboration between the FGSA and the FEEd will help bring more young physicists to be participants in the larger physics teaching community and encourage their membership in the FEEd and the AAPT.

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Teacher Preparation Section

John Stewart, Editor

In this issue of the Teacher Preparation Section, we will focus on funding for physics teacher training efforts. Joan Prival, a Program Director at the National Science Foundation, will discuss the new Robert Noyce Teacher Scholarship Program solicitation. At our own institution, this program has been invaluable in our efforts to increase the number of qualified undergraduate physics majors entering the teaching profession.

Most funding for teacher preparation efforts is governmental; there are, however, a number of excellent examples of corporate support for physics teacher preparation programs. In the Summer 2007 edition of this newsletter, three articles discussed examples of corporate support: the broad corporate funding of UTeach, IBM's *Transition to Teaching* program, and Boeing's partnership with Seattle Pacific University. In this edition, Mark Mattson will discuss Toyota's funding of teacher preparation efforts at James Madison University.

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The National Science Foundation's Robert Noyce Teacher Scholarship Program

Joan Prival

National attention continues to focus on the urgent need for qualified mathematics and science teachers. The need is particularly acute in high poverty schools and in the physical sciences. The National Science Foundation's **Robert Noyce Teacher Scholarship Program** seeks to encourage talented science, technology, engineering, and mathematics majors and professionals to become K-12 mathematics and science teachers. Initiated in 2002, the program was reauthorized in 2007 through the America COMPETES Act. The program provides funds to institutions of higher education to support scholarships, stipends, and academic programs for undergraduate STEM majors and post-baccalaureate students holding STEM degrees who commit to teaching in high-need K-12 school districts. A goal of the Noyce program is to recruit individuals with strong STEM backgrounds who might otherwise not have considered a career in K-12 teaching. Scholarship and stipend recipients are required to complete two years of teaching in a

high-need school district for each year of scholarship or stipend support.

A new component of the 2009 program, the NSF Teaching Fellowship and Master Teaching Fellowship track, has been added to the new Noyce Program solicitation (NSF-09-513). This track supports STEM professionals (recent STEM graduates as well as STEM "career-changers") who enroll as NSF Teaching Fellows in master's degree programs leading to teacher certification by providing academic courses, professional development, and salary supplements while they are fulfilling a four-year teaching commitment in a high-need school district. This new track also supports the development of NSF Master Teaching Fellows by providing professional development and salary supplements for exemplary math and science teachers to become Master Teachers in high-need school districts with a five-year teaching commitment.

Noyce Scholarship projects include partnerships with school districts, recruitment strategies, and activities to enable the Noyce Scholarship recipients and NSF Teaching Fellows to become successful elementary or secondary math and science teachers. The project leadership team is expected to include STEM discipline faculty and education faculty working in collaboration with school districts and master K-12 teachers.

The Robert Noyce Teacher Scholarship Program accepts proposals representing two different tracks: The **Robert Noyce Teacher Scholarship** track provides funding to colleges and universities to provide scholarships and programs for undergraduate students majoring in STEM disciplines and stipends for STEM professionals seeking to become teachers. Phase I proposals may be submitted by institutions that have not been previously funded under the Robert Noyce Teacher Scholarship Program or are requesting funding to support Noyce Scholars from a department or academic unit or program that has not participated in a previous Noyce Award. Phase II proposals may be submitted by institutions that have been previously funded under the Robert Noyce Teacher Scholarship Program if the previous grants are near completion. Phase II proposals include support for additional scholarships and stipends as well as support to conduct longitudinal evaluation studies of previously supported students as they begin teaching. The Robert Noyce Teacher Scholarship Track supports:

Scholarships for STEM Majors Preparing to Become Teachers: Scholarships of at least \$10,000 per year (not to exceed the cost of attendance) are available to juniors and seniors majoring in a STEM discipline. Scholarships may be awarded for up to 3 years to include a fifth year of study in a post-baccalaureate teacher-credentialing program.

Stipends for STEM Professionals: Stipends of at least \$10,000 (not to exceed the cost of attendance) are available for a maximum of one year for STEM professionals who hold a baccalaureate, masters, or doctoral degree in science, mathematics, or engineering and enroll in a teacher certification program.

Summer Internships: Proposals may include summer internships for undergraduate freshmen

and sophomores to introduce students to early experiences in STEM education and provide examples of the integration of research and education. Settings for internships may include formal and informal STEM education venues, such as summer science and math camps, summer school, science museums, nature centers, or science research laboratories.

Projects include program development and enhancement as well as programmatic support for students to enable the recipients to become successful math and science teachers. For example, Noyce Scholars are often mentored by master teachers and college faculty while they are preparing to become teachers and as they begin teaching in the schools. Program components are designed to attract students into teaching, provide high quality preparation for their success as teachers, and to retain them in the teaching workforce. These activities may include early field experiences, academic courses in content and pedagogy, and professional development and mentoring support for new teachers. In addition to monitoring the Noyce Scholars and Fellows to ensure they complete the teaching requirement, all projects are expected to include an objective evaluation that provides both formative assessment of progress and summative evaluation of project outcomes.

- Maximum Award Amount for Phase I: \$900,000 over 5 years.

- Maximum Award Amount for Phase II: \$600,000 over 4 years.

The new **NSF Teaching Fellowships and Master Teaching Fellowships** track offers awards to institutions in partnership with high-need school districts and non-profit organizations to administer fellowships and programmatic support to STEM professionals (NSF Teaching Fellows) who enroll in a master's degree program leading to teacher certification or licensing and fellowships to mathematics and science teachers (NSF Master Teaching Fellows) who have a master's degree and participate in a program for developing Master Teachers. As required by the America COMPETES Act, an institution submitting a proposal under this track must provide matching funds, from non-federal sources, equal to 50 percent of the amount of the grant request.

• Maximum Award Amount: \$1,500,000 over 5 -6 years.

Planning grants of up to \$75,000 are available for institutions to spend up to a year developing the partnerships and planning for a future Noyce proposal under the NSF Teaching Fellowships and Master Teaching Fellowships track.

The NSF Teaching Fellowships and Master Teaching Fellowships Track supports:

NSF Teaching Fellowships: Stipends of at least \$10,000 (not to exceed the cost of attendance) and programmatic support are provided to STEM professionals who enroll in a one-year master's degree program leading to teacher certification or licensing. Institutions provide academic courses, activities, and clinical teaching experiences for the NSF Teaching Fellows. Projects provide mentoring and professional development while the Teaching Fellows are fulfilling their four-year teaching requirement in a high need school district. The Fellows receive a salary supplement of at least \$10,000 per year while they are fulfilling the four-year teaching commitment.

NSF Master Teaching Fellowships: Institutions offer academic courses, professional development, and leadership training to prepare participants to become Master Teachers in elementary and secondary schools. Fellows receive salary

supplements of at least \$10,000 for each year of the five-year teaching requirement.

The current portfolio of 125 active awards in the Noyce program includes a total 240 institutions of higher education and over 850 school districts in 36 states and the District of Columbia. Awards made between fiscal Years 2002 and 2008 are projected to produce approximately 4,900 new science and mathematics teachers for the nation's high-need school districts. Among the awards made in 2008 is an award to the American Physical Society in partnership with the American Association of Physics Teachers and a consortium of six PhysTEC institutions who will collectively award Noyce scholarships to 30 future physics teachers.

The current program solicitation and links to abstracts of current awards can be found on the NSF website at

http://www.nsf.gov/funding/pgm_summ.jsp?pims_id=5733&org=EHR&from=home.

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Private Funding for Physics Teacher Preparation at James Madison University

Mark Mattson

Early in the summer of 2007, the Department of Physics and Astronomy at James Madison University (JMU) received \$255,365 from the Toyota USA Foundation to fund the University's efforts in the development and training of physics and physical science teachers in the state of Virginia in general and in the Shenandoah Valley region in particular. The money is being used over a 3-year span to endow a faculty-level position for a physics teacher-in-residence (TIR) as well as a summer/fall program that mirrors the efforts of the Physics Teaching Resource Agents (PTRA)[1]. As

of this writing, the program has fully completed the activities scheduled for the first year, is well into the second year, and is already planning for the third and final year for which these funds are available. Efforts to seek funding for additional years are being planned. Despite initial hopes that the University would permanently provide for the TIR position, the current state of the economy dictates that an external source will have to provide those funds.

The ideas behind the grant proposal arose from ideas already well established in the physics

education community. The usefulness of a physics TIR has been established by the Physics Teacher Education Coalition (PhysTEC)[2]. Programs at Western Michigan University, the University of Arkansas and other institutions have documented success in the recruitment and training of pre-service teachers in their implementation of this idea. The other aspect of the grant proposal incorporates a weeklong summer workshop each year with follow-ups in the fall for in-service teachers that mirrors the successful PTR program. As with the TIR program, there was documented success in what the PTR program has done, but this time it was in terms of generating renewed enthusiasm among in-service teachers as well as providing them with workable techniques from the results of the latest research in physics pedagogy.

Despite some concerns over some of the issues of using funds from a non-government entity [3], it was decided early on in the process of developing the proposal to seek funds from a private source rather than a state or federal source. This choice was made as private foundations tend to have more flexibility in what they are willing to fund; government requests for proposals tend to have more specific targets. It was thought that a government-funded source such as the Math-Science Partnership[4] would be good for one aspect of the entire proposal, but a single funding source for all aspects of the project was preferable.

With the choice made that a private foundation would be solicited, it was vital to find foundations that were most likely to be receptive to the ideas being submitted. There are many corporate foundations and many of them include the funding of education-related endeavors in the mission; however, not all of them feature STEM education as part of their mission. For example, the GE Foundation[5] has education of minorities as a primary target. The foundation should have a history of issuing awards of the desired size and for projects in the desired geographical region. For example, the Bayer USA Foundation will consider funding worthy proposals in the field of STEM education but will tend to award applications only from states in which the company has a presence [6]. With these considerations, it was found that the Toyota USA Foundation had all the qualifications needed [7]. Their mission statement

says that the company is “committed to improving education by supporting programs that offer the tools and training to help enrich people’s lives” and they fund “K-12 educational programs that focus on the areas of math and science.” In addition, in 2005 they awarded \$200,000 to Virginia Tech [8]. The author notes with both pride and acknowledgement to luck that the Toyota USA Foundation was both the first and the last organization to which this particular grant proposal was submitted.

The ideas behind the proposal and the selection of the potential funding source were, comparatively speaking, the easy parts. The devil, as usual, took up residence in the details. Given the relatively recent upsurge in publicity associated with the need to promote STEM education, there was a receptive climate for the ideas. However, without a noteworthy commitment from different elements within the University, the odds of successfully being funded would be small. One of the significant attractions in the proposal was that there would be a noticeable increase in communication and cooperation between the Department of Physics and Astronomy and the College of Education with the expectation that this would be, more or less, a permanent institutional change. As envisioned in the proposal and as subsequently implemented, the physics TIR would be involved in the pedagogical methods course taught in the College of Education and would also play a major role in the practicum course for pre-service STEM teachers. These duties were in addition to the stated responsibility of the physics TIR to teach an introductory course in the Physics Department and otherwise participate as a faculty member within it. As a demonstration of this commitment, the proposal included letters of support from the Head of the Department of Physics and Astronomy, the Dean of the College of Science and Mathematics, and the Associate Dean of the College of Education. Additional letters of support were submitted by the University’s Vice Provost of Outreach and Engagement and Theodore (Ted) Hodapp, one of the PI’s for the PhyTEC program. These letters addressed issues related to internal support of the proposal as well as viability at JMU. The letters did not address any commitment by the University to fund any of these programs on a permanent basis after the three-year period. The

letters showed that the powers-that-be from different parts of the University genuinely viewed this proposal as a significant means of enhancing the University's mission.

Upon receipt of the funds, an interesting dilemma arose. The money was received early in the summer of 2007, too late to set up a weeklong summer institute for 2007 and probably too late to hire a TIR. Teachers tend to know their plans for the upcoming academic year no later than the preceding March. It was, therefore, too late to recruit any in-service teachers to be TIR. However, the Department of Physics and Astronomy has had a relationship with a number of local physics teachers for many years as they are often employed part-time to help out with introductory physics labs. One of these teachers, James (Jim) Butt, had recently retired. Jim met all of the necessary qualifications to be the TIR; he had a Master's degree and had spent 10 years teaching high school physics at a nearby school. Jim had even attended JMU's PTRAs rural institute earlier this decade. Perhaps somewhat charitably, Jim agreed to be JMU's first physics TIR.

Jim was assigned a section of the introductory, calculus-based University Physics course; however, his section was held in one of the rooms for introductory labs. With the help of the departmental equipment manager, Art Fovargue, this enabled Jim to more readily utilize laboratory and demonstration materials to give students a more hands-on experience. Jim also followed some of the approaches detailed in "The Active Learning Guide" by Alan Van Heuvelen and Eugenia Etkina. Jim found it a very interesting and invigorating experience—while he had used active learning techniques in his classes, he had never fully committed to them to such an extent. Jim assessed the effectiveness of this approach using the Force Concept Inventory (FCI). His section showed an average Hake gain of 0.29. While this gain is low for a typical active learning-based class, it nevertheless represented a significant improvement over the average Hake gain for students in a typical lecture course. Jim still teaches part-time and has said that he plans on using active learning techniques more aggressively in his courses.

The short turn-around between receiving the grant, confirming Jim's hiring, and the start of the 2007 fall semester made it impossible for Jim to play a role in the practicum course the College of Education requires of those seeking certification. Instead, Jim worked with David Slykhuis of the Department of Middle, Secondary, and Mathematics Education in co-teaching the pedagogical methods course taken by STEM education majors. This gave students within the course a valuable opportunity to have extensive interactions with a teacher who's been "in the trenches" and also demonstrated the commitment to developing greater communication between the different departments and colleges. In the following semester, when there was adequate time to do the necessary arrangement of schedules, Jim was placed in a position where he could help out with the practicum course. This also exposed the physics teachers in the region to this program at JMU, increasing the likelihood of finding qualified people to serve as TIR's in future years.

During the current 2008-09 academic year, the physics TIR at JMU is Thomas O'Neill. He is on an approved year-long leave of absence from the Shenandoah Valley Regional Governor's School. Thomas has a history of using active learning techniques and has applied them to his section of University Physics; when he administered the FCI, the average Hake gain for his class was 0.46. Thomas has also continued working with David Slykhuis in both the pedagogical methods course and the students' practicum. As of this writing, efforts are currently underway to secure a TIR for the 2009-10 academic year with the hope that the task will be accomplished by March 2009.

The PTRAs-like workshops were instituted in the summer of 2008. William (Bill) Ingham of the JMU Physics Department ran one of the inaugural rural institutes for the PTRAs from 2002 through 2005. This established a helpful baseline for the program funded by the Toyota USA Foundation. Master teachers Deborah Roudebush and John Roeder, who had worked with Bill under the aegis of PTRAs, were willing to work again under this program. Recruiting teachers to participate in the workshop and handling administrative details such as room and board were handled through a partnership with one of the flagship programs run by the College of Education at JMU, the Content

Teaching Academy (CTA)[9]. The CTA is essentially an umbrella organization that provides learning experiences for teachers from across the state. The CTA is run as a concurrent set of week-long workshops during the summer that cater to many of the different disciplines such as math education, elementary education, and special education. Since money was coming from the Toyota USA Foundation, the administrators of the CTA were willing to incorporate a physics-related workshop into their administration. This includes the afore-mentioned matters of recruitment and room and board but the equally important matter of documenting the teachers' participation and ensuring it counts towards their recertification. Having the CTA orchestrate the recruitment also resulted in a somewhat different dynamic for the population of participants. The CTA has a good reputation among teachers and administrators in public school districts across the state and is, therefore, able to attract more teachers from the middle-school level. About 20% of the teachers who came to the workshop were from middle schools, which contrasts with less than 10% when JMU was hosting the PTRA rural institute a few years earlier. Unlike the typical workshops held by the CTA, all the teachers were invited to follow-up workshops held on two different Saturdays during the subsequent fall. These workshops, following the PTRA architecture, allow the participants to get together and reflect on the successes and difficulties of incorporating the techniques they learned during the summer workshop. As an inducement to attend, the teachers were each given \$10/hour as well as expenses to cover their mileage.

A survey of teachers who participated in the summer workshop was generally very favorable. Nearly all of the teachers indicated interest in attending the workshops in 2009 and 2010. The 2008 summer workshop focused on Galilean and Newtonian physics, while the 2009 and 2010 workshops are expected to focus on electromagnetism and thermodynamics, respectively.

The Toyota USA Foundation-funded program at JMU to improve the preparation and qualifications

of physics and physical science teachers has, to date, met the goals outlined in the original proposal. Ongoing assessments continue to inform handling of the TIR and pseudo-PTRA programs and will be used to justify the need for future funding. While it is irrelevant whether subsequent funding is from private sources or government sources, there is the hope that the existence of this program will stimulate professionals from other institutions to consider alternative sources to support STEM education and teacher preparation.

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[2] Physics Teacher Education Coalition (PTEC), <http://www.ptec.org>

[3] Washburn, Jennifer, "Science's Worst Enemy: Corporate Funding", *Discover Magazine*, published online Oct. 11, 2007, <http://discovermagazine.com/2007/oct/sciences-worst-enemy-private-funding>

[4] Math Science Partnership (MSP) <http://www.ed.gov/programs/mathsci/resources.html>

[5] General Electric Foundation http://www.ge.com/foundation/about_ge_foundation/index.jsp

[6] Bayer USA Foundation <http://www.bayerus.com/Foundation/Geo.aspx>

[7] Toyota USA Foundation http://www.toyota.com/about/our_commitment/philanthropy/education/toyota_usa/

[8] Broughton, Sandy, "Toyota grant will fund new technologies in state classrooms", *Spectrum*, <http://scholar.lib.vt.edu/vtpubs/spectrum/sp980305/1e.html>

[9] Content Teaching Academy <http://www.jmu.edu/contentacademy/>

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