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Forum on Education
American Physical Society

Fall 2011 Newsletter

Andrew Elby, Editor

IN THIS ISSUE:

From the Chair

Chandralekha Singh

Fall is a busy time for FEd activities. Renee Diehl, the FEd Chair-elect, is the Chair of the FEd Program Committee for the APS 2012 March and April meetings. She is working very hard with other members of the FEd Program Committee to organize excellent invited sessions sponsored or co-sponsored by FEd, for the March meeting in Boston and the April meeting in Atlanta, on graduate, undergraduate and K-12 education and outreach. Paul Cottle, the FEd Vice-Chair, is the Chair of the FEd Nominating Committee, charged with nominating candidates for next year's Vice-Chair and the two members-at-large (one of whom must also be an AAPT member). I hope you already responded to his call for suggestions for candidates for any of these FEd positions.

I want to encourage you to consider those who should be nominated for two award/fellowship opportunities. One is the APS Excellence in Physics Education Award, with details at http://www.aps.org/programs/honors/awards/education.cfm The other is an APS Fellowship sponsored by the Forum on Education. See the *Call for Nominations: Awards and Fellowships* article in this newsletter for details.

I also want to remind you of a new award by the APS Committee on Education (COE). This **Award for Improving Undergraduate Physics Education** recognizes best practices in undergraduate physics education. See http://www.aps.org/programs/education/undergrad/faculty/award.cfm for details. The deadline for nomination is July 15.

Finally, the Editors for the Spring and Summer 2012 newsletters are Paul Dolan and Richard Petersen. Please consider writing an article for either of these upcoming newsletters. You can send articles directly to the Editors.

Chandralekha Singh is a Professor in the Department of Physics and Astronomy at the University of Pittsburgh. She is Chair of the APS Forum on Education. She is also the Chair of the editorial board of the Physical Review Special Topics: Physics Education Research.

FFPER 2011 Working Group Reports

Rachel E. Scherr and Andrew Elby

The Foundations and Frontiers of Physics Education Research (FFPER) conference is held every other year in Bar Harbor, Maine. The conference is a venue for specialists who are active researchers in the field of physics education. This intensive week-long residential meeting provides a forum for examining and articulating the current state of the field, exploring future directions, and discussing ways to pursue the most promising avenues for future research. Evening activities at the conference include working groups whose task is to develop a well-articulated position on a topic of community-wide interest. The following three articles are reports from the Working Groups at the 2011 FFPER.

FFPER Working Group Report: Models for a PER Summer School

Rachel E. Scherr and Michael C. Wittmann

Working Group Participants: Ruth Chabay, Urban Eriksson, Brian Frank, Liz Gire, Renee Michelle Goertzen, Kara Gray, Shulamit Kapon, Sandy Martinuk, Cassandra Paul, Ed Prather, Mel Sabella, Chris Shubert, Mac Stetzer.

A high-quality PER summer school would enable participants to deepen their understanding of PER and connect to a community of physics education researchers and reformers. Our working group found broad, strong areas of consensus about key characteristics of a PER Summer School:

- It should be "camp": an immersive, fun, bonding experience in which people's common experience builds long-lasting relationships.
- It should authentically engage a range of levels of expertise.
- It should have plenty of unstructured time.
- It should be 1-2 weeks long.

The PER Summer School working group explored a number of visions for a PER summer school, each with a different focus and audience. Four models emerged from our discussions.

1. "Intro school": The primary purpose would be to bring people into physics education research and help give them a strong start, both intellectually and in terms of a professional network. Led by PER experts, the school would include new graduate students, teachers with a PER interest, and faculty transitioning into PER from other fields. The school would be the largest of the four models proposed, serving perhaps 25-75 people each time it was offered. This school model is comparable to the model of AAPT's New Faculty Workshop. It is championed by Ed Prather (University of Arizona).
2. "Research school": This school would offer active physics education researchers the opportunity to learn and apply specific state-of-the-art methods from experts in those specific areas (e.g., clinical interviewing, quantitative analysis). Experts might come from within or outside the PER community. The school would likely serve 10-20 researchers at a time. This model is similar to the summer school offered to active biology researchers at the Marine Biology Laboratory at Woods Hole. Elizabeth Gire and Shulamit Kapon champion this model.
3. "Bring your own research": At a "BYO" school, active researchers would bring work in progress in order to benefit from collaboration and informal peer review with peer researchers, advised by experienced researchers. The school, which would likely serve 10-20 researchers at a time, shares features with the International Conference of the Learning Sciences (ICLS) Doctoral Consortium. This model is championed by Michael Wittmann and Sandy Martinuk.
4. "Summer research institute": In a Summer Research Institute (SRI), a team of active researchers gathers to document and study a rich instructional context with a common, rich data set. Peers mentor one another in a dynamic, problem-oriented framework and develop collaborations based on their work together, under the advising of experienced directors. 10-20 researchers participate at a time. The PER community has a model of a successful SRI in the Energy Project SRI. Rachel Scherr champions this model.

These models are not in competition; each serves a different purpose and would be realized by different means. Each model's champions are pursuing the creation of the school that their team envisioned. For questions about a particular summer school model, or to assist, please contact the champion for that model.

Model	*Focus*	*Leaders*	*Audience*	*# people*	*Compare to*	*Champion*
Intro	PER induction and kickstart	PER experts	New grad students, teachers, PER-interested faculty	25-75	New Faculty Workshop	Ed Prather eprather@as.arizona.edu
Research	Learn and apply state-of-the-art PER methods	PER & outside experts	Active researchers	10-20	Woods Hole	Elizabeth Gire egire@memphis.edu Shulamit Kapon shulamit.kapon@berkeley.edu
BYO	Peer review / collaboration for progress on your own work	Peers (advised)	Active researchers	10-20	ICLS Doctoral Consortium	Michael Wittmann mwittmann@maine.edu Sandy Martinuk sandy.martinuk@gmail.com
Summer Research Institute	Collaborative study of rich local data set	Peers (advised)	Active researchers	10-20	Energy Project SRI	Rachel Scherr rescherr@gmail.com

FFPER Working Group Report: Selected Readings for Physics Education Researchers within and beyond PER

By Kathy Perkins and Sam McKagan

Working Group participants: Leslie Atkins, Ian Beatty, Warren Christensen, Brian Danielak, Jason Dowd, Tobias Fredlund, Jenaro Guisasola, Ayush Gupta, Benedikt Harrer, Paula Heron, Brant Hinrichs, Eric Kuo, Sissi Li, Cedric Linder, Beth Lindsey, Sam McKagan (Co-Chair), Victoria Nwosu, Kathy Perkins (Co-Chair), Valerie Otero, Vashti Sawtelle, Phil Southey

History: At the first FFPER meeting in 2005, a working group chaired by John Thompson and Brad Ambrose assembled to compile "a list of publications describing research on the teaching and learning of physics that are considered primary and necessary by everyone in the field." (http://www.aps.org/units/fed/newsletters/fall2005/canon.html) A primary list of 25 publications was identified as essential readings for physics education researchers, along with a secondary list of about 50 publications also identified as essential but either not the first of their kind or outside of PER.

A new goal: Physics education research (PER) has seen tremendous growth in the number of researchers, in the span of research questions, and in the types of research methodologies used. In many cases, research directions – both new and longstanding – are grounded in or inspired by work in fields outside of PER, such as education research, cognitive science, learning sciences, educational psychology, behavioral science, other discipline-based education research fields, etc. In addition, PER community members often wear many hats – researcher, professional development provider for TAs or faculty, curriculum developer, or departmental /institutional resource for questions on teaching, learning, and course reform. With this context in mind, the goal of this working group was to create a compilation of publications within and beyond the PER literature to broadly serve the community. This resource was envisioned as comprehensive enough to include all areas of PER, theories that underlie our work, methodologies used in PER research, and other specific research areas that have influenced our field and its work. The resource is not meant to include all papers on a particular topic (e.g. constructivism, metacognition, interactive engagement, teacher preparation, qualitative methods), but to provide one to three papers as a good foundational starting point for learning about that topic or sub-topic.

The Audience: Our group settled on creating a resource that best serves us: practicing physics education researchers. Other groups that might benefit from this resource include graduate students beginning a Ph.D. in PER; faculty and students of a "Teaching and Learning Physics" course; and college faculty or high school teachers interested in physics course reform. To make this resource most useful, we sought a dissemination mechanism that enabled a flexible "tagging", allowing identification of publications within the broader list that are well-suited to different audiences.

The Selection Process: Working before the FFPER conference itself, we identified 5 main categories, with an initial list of topics under each category:

1. Theories (e.g., constructivism, socio-cultural perspectives, situated cognition, conceptual change)
2. Studies related to students and learning, both general (e.g., analogies, problem solving, epistemology, cognitive load) and content specific (e.g., student difficulties at various levels)
3. Pedagogical Approaches and Implementation Strategies (e.g., tutorials, classroom response systems, simulations, group work)
4. Teacher Training and Faculty Change (e.g., teacher content knowledge, faculty change, nature of science)
5. Research Tools and Methodologies (e.g., qualitative and quantitative methods, assessment development, statistics)

At the conference, the working group divided itself into 5 subgroups corresponding to these categories identified and discussed possible papers for inclusion. Selected papers generally met one or more of the following criteria:

- Foothold papers – introduce diverse, but relevant, ideas upon which PER builds.
- Generative papers – drive forward future research.
- Exemplary papers –provide good examples of a particular kind of research, methodology, or pedagogy
- Literacy in PER – help readers to understand and converse in PER
- Historical value – offer historical perspective in PER

Dissemination and Growth: In order to make the selected articles easily accessible, capable of being tagged and commented upon, and dynamic (e.g., new articles could be added in the future), the working group decided to disseminate the list on comPADRE and as PERticles. PERticles is a collection of PER articles hosted on CiteULike (www.citeulike.org); within this collection, publications have been added and tagged with "SelectedReadings_2011" and with any additional tags identified by the working group during the selection process. (The tags "Canon_2005" and "Canon_2005_BList" identify the canon developed by the FFPER working group in 2005.) comPADRE will also host the final document of selected 2011 publications, organized by category and sub-topics (http://www.per-central.org/ffper/working-groups/2011/selected-readings/).

The field is continuing to grow and evolve, developing new pedagogies, applying new methodologies, and drawing ideas from diverse fields. We encourage the community to participate in further development of this resource by adding papers to PERticles

and tagging them with "SelectedReadings_Candidate". With this practice, the compilation of papers can benefit from and reflect the expertise and work of the entire PER community. We thank you in advance for your efforts! (Note: The working group so enjoyed reading individuals' personal suggested reading lists that we also suggest adding a collection of articles to PERticles tagged with your name.)

Acknowledgements: We would like to thank all the members of our working group, along with everyone who gave us their suggested readings ahead of the conference: Ayush Gupta, Joe Redish, the CU and UBC Science Education Initiatives, and the CU PER Group, especially Stephanie Chasteen, Noah Podolefsky, Kara Gray, Mike Ross, and Ben VanDusen.

FFPER Working Group Report: NRC commissioned report on Undergraduate Physics Education

Suzanne White Brahmia, Jennifer Docktor and Jose Mestre

Participants: Saalih Allie, Ian Beatty, Andrew Boudreaux, Suzanne Brahmia, Eric Brewe, Hunter Close, Sebastien Cormier, Dedra Demaree, Jennifer Docktor, Jenaro Guisasola, Mark Haugan, Steve Kanim, Laird Kramer, Mila Kryjevskaia, Michael Loverude, David Meltzer, Jose Mestre, Lillian McDermott, Edward (Joe) Redish, Peter Schaffer, John Thompson, Jing Wang.

Background Information

The NSF has sponsored a National Research Council (NRC) committee called *Undergraduate Physics Education Research and Implementation (UPE)* (http://sites.nationalacademies.org/BPA/BPA_059078). This committee is charged to assess the current status of Physics Education and PER, including

- how well current undergraduate physics education programs attract, retain, and serve physics majors, other science/engineering/technology pre-professionals, and current/future K-12 teachers, with best practices identified
- a synthesis of key PER findings and productive future directions
- an examination of the efficacy of current assessment methods, with a focus on scaling up assessment tools that can help sustain exemplary instruction

Our working group aimed to provide feedback that can be taken back to the NRC UPE committee currently engaged in writing a decadal study of PER.

Process

Working group members collected their thoughts before the conference about the role PER could play over the next decade in improving undergraduate physics education and what research directions and questions are likely to be most fruitful. In addition, the Physics Education Research Leadership and Organizing Committee (PERLOC) emailed researchers not in our working group to solicit input regarding any omissions from the working group's outline. PERLOC members John Thompson and Eugenia Etkina organized the responses.

Working Group Recommendations for the NRC UPE report

1. *NSF funding:* NSF should create a PER section in the Physics program, and the UPE committee should make a formal recommendation along those lines.
2. *Underrepresented groups in physics:* The UPE report should reflect the pressing and growing need to improve our knowledge about teaching and learning of students from groups underrepresented in physics.
3. *Future teachers of physics:* The UPE report should emphasize physicists' important role in preparing future teachers and professors of physics.
4. *Promising research directions:* NSF should be made aware of the most promising current research directions in PER so that PER can continue to maximally benefit undergraduate physics education. Areas of active research that are anticipated to be important in the next decade include:

- *Models and Theories*: student thinking before, during and after instruction; development of student reasoning skills; transfer and the preparation for future learning; the effect of technology on student learning and behaviors (online homework, social networking, etc.); cognition and cognitive processes in physics; use of tools and technology to study evolution of student thinking on small time scales (video, eye-tracking, fMRI, response time, etc.); context-dependence of student thinking and knowledge; nature of expertise – problem solving and science process skills; examination of what cognitive processes are physics specific and what overlaps with other problem-solving disciplines (math, chemistry, engineering, etc.); and role of language and writing in learning physics.

- *Applied Educational Transformation:* curriculum development, methods that model the practice of science, materials development and effective use of technology, learning environments and communities, broadening outcomes and learning objectives, expanded concepts of assessment and evaluation, faculty development, role of undergraduate leadership, needs of specific populations (pre-meds, majors, underrepresented groups, learning differentiation, etc.), sustainability, longitudinal studies, interdisciplinary and cross-disciplinary methods, and inclusion/diversity/equity.

- *Teacher Professional Continuum:* K20 recruitment and practice, assessments of classroom instruction, faculty development and practice, graduate student teaching assistant and undergraduate learning assistant development and practice, adaptation and innovation in the classroom, barriers to change and approaches to addressing these, and educational environments and interactions with instruction.

Physics Teacher Education Coalition

Section on Teacher Preparation

Teacher Preparation Section

John Stewart, University of Arkansas

In this issue, continuing a series of articles on ComPADRE collections that are of interest to teachers, we start with Ed Lee's article on Physics To Go (http://www.physicstogo.org/). Physics To Go contains articles of interest to the broader community and is an excellent reference for teachers wishing to direct students to interesting reports on exciting topics in physics. The site also contains instructional resources to facilitate the use of these materials in the classroom.

Our second article discusses the Science Math Teacher Imperative (SMTI), a major initiative by the Association of Public and Land-grant Universities (APLU). Howard Gobstein, the Executive Vice President of APLU and Co-director of SMTI, introduces the initiative, which applies the resources of APLU to the problem of increasing the number and quality of STEM teachers. The 2012 PhysTEC Conference, focusing on *New Paradigms for Physics Teacher Education*, will be held in conjunction with the AAPT Winter Meeting, Feb. 3-4, 2012 in Ontario, California. Information about registration and submission of abstracts will be posted at ptec.org.

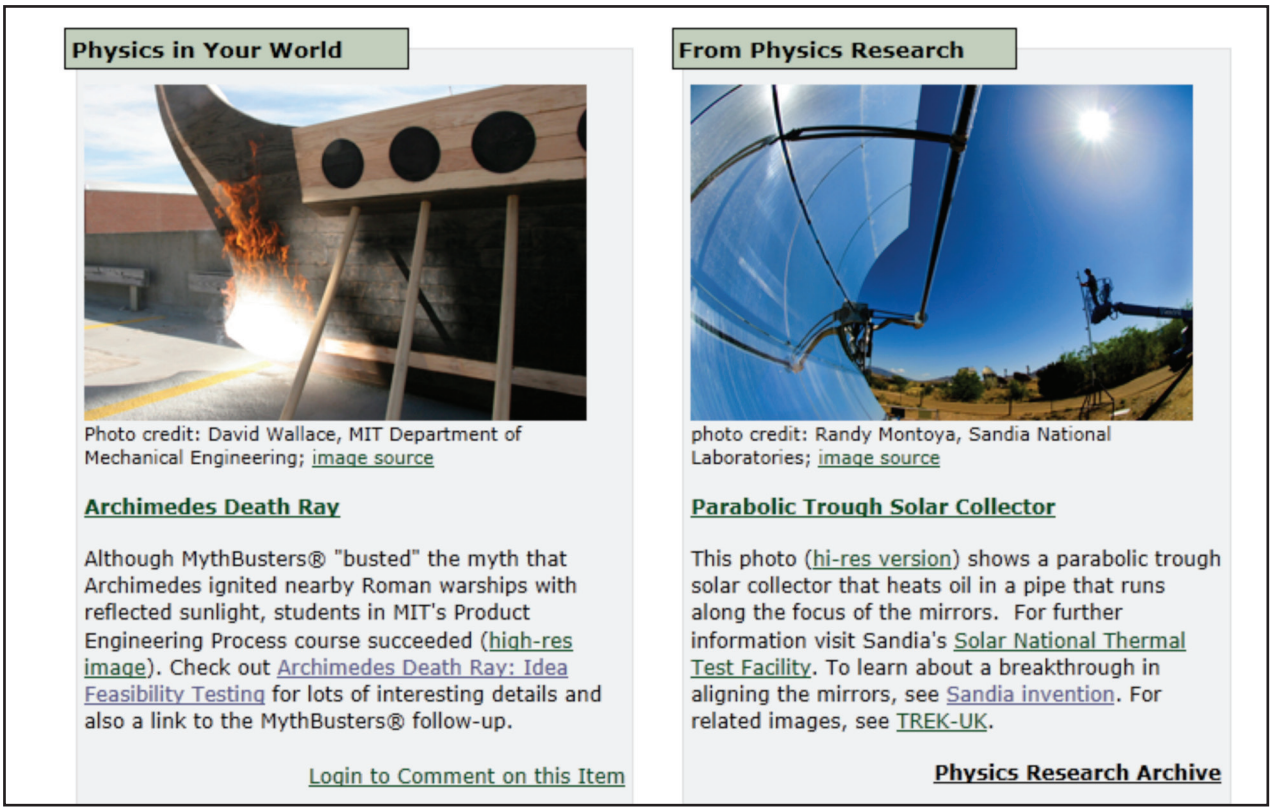
John Stewart is a physics professor at the University of Arkansas

Physics to Go: the outreach Compadre collection

Ed Lee

Physics to Go (www.physicstogo.org), the Compadre collection for informal physics learning, is a general-interest physics digital library that debuted in 2004. Visitors can search and browse more than 920 cataloged websites on introductory physics and related fields. These sites include articles about physics research, simulations to help people understand physics principles, "hands-on" activities for learners of various ages, and more. These sites are chosen to be reputable and accurate; most are produced by a university physics or engineering department, a national lab, or a physicist.

Homepages. Each Physics to Go homepage contains two images. For example, below is part of Issue 34, Death ray/solar power.



The homepage feature *Physics in Your World* offers images from more-or-less everyday life, as in the example above, and *From Physics Research* offers images from physics, astrophysics, astronomy, and engineering. On a given homepage, both images illustrate the same or related phenomena. The other two homepage features are *Physics at Home*, typically featuring hands-on activities or computer simulations on the same topic as the two images, and *Worth a Look*, which offers additional links to sites on the same topic or a related one. New homepages appear every month or so and stay up for about two weeks; during the other half of the month, archived issues shuffle on and off the homepage, staying up for four days at a time.

Archive. The 100+ old homepages are archived for easy browsing and searching Physics. and art is an important theme of the Physics to Go collection and is featured in more than 10% of the archived homepages. For some examples, see Issue 65, Mirrored room, and Issue 83, X-rays in art & science. Teachers can send students to relevant sites in the collection to work with a simulation or read an article, such as those in Issue 72, Crash test/ion drive, or Issue 114, Free fall. Students could also do research for homework or special projects.

In summary, Physics to Go is an outreach website with a dual identity–it's both a collection of physics sites for informal learning and a monthly illustrated physics mini-magazine.

Ed Lee retired from the American Physical Society in 2010, after 12 years of work in education and outreach. His prior work includes 12 years of teaching, five years of museum education, and work on several curriculum development projects.

It Takes a University: Re-Envisioning a Role for University Associations to Support STEM Faculty to Prepare Future Science Teachers

Howard Gobstein

Introduction

For those interested in improving STEM (science, technology, engineering and mathematics) education, present intense national attention offers immense potential. November 2011 marks the third anniversary of the launch of the Association of Public and Land-grant Universities' (APLU) Science and Mathematics Teacher Imperative (SMTI). As the Executive Vice-President of APLU and the Co-Director of SMTI, I appreciate this opportunity to discuss how we strive to support and complement the important work of faculty in a vital portion of reform – ensuring well-prepared science and mathematics teachers.

The APLU is a 220-member association of public research universities including all the Land-grants and several dozen major university systems. The time is ripe for significant progress. There is hardly a day during which I don't see an announcement of a seminar or talk by a national group either decrying lagging international competitiveness in student achievement or in some other way touting their dedicated efforts in education reform – much relating to STEM.

APLU has stepped up to the challenges of increasing the number and improving the preparation of science and mathematics teachers in its member institutions. As the President's Council of Advisors on Science and Technology noted a year ago in *Prepare and Inspire*, its report to President Obama, "the recent commitment to improve teacher education by more than 120 higher education institutions through the Association of Public Land-grant Universities' Science and Mathematics Teacher Imperative is a move in the right direction." Indeed, President Obama personally offered plaudits to several university presidents during an Educate to Innovate celebration at the White House in January 2010. I assert that a year later we have taken even greater moves in this right direction: APLU's SMTI is the most ambitious effort in the nation thus far to help public higher education institutions assess and improve the quality, and increase the number, of K-12 science and mathematics teachers.

As I write this essay in mid September, our colleagues at the Association of American Universities (AAU) – an association of major public and private research universities – are announcing a parallel ambitious initiative to help institutions assess the quality of undergraduate STEM teaching on their campuses, share best practices, and create incentives for their departments and faculty members to adopt the most effective teaching methods in their classes: see http://www.aau.edu/policy/article.aspx?id=12588

As interest in science teaching and learning continues to grow by many kinds of organizations around the nation, it is timely to review how SMTI emerged. As SMTI plans for the future, we seek guidance from physics faculty, particularly those engaged in PhysTEC (see *Teacher Preparation Section* article in this issue).

How SMTI came about and connected with PhysTEC

In 2006, I was charged with developing an APLU-led initiative to respond to the recommendations of the National Academies' *Rising Above the Gathering Storm.* The first recommendation – the highest priority of the report – was to prepare 10,000 new science and math teachers. We took time to carefully identify the most appropriate role for APLU in teacher preparation, establishing an ad-hoc commission led by the Chancellor of the University of Illinois, Urbana-Champaign. Joining him were several university presidents and provosts, STEM and education faculty, former governors, a chief state school officer, an urban school superintendent and two practicing teachers. By late 2007/early 2008, we were engaged in substantive discussions with our own APLU groups, such as our councils of presidents and of provosts. We also reached out to outside groups. It was in the hall of a Senate office building, outside a hearing room, that I first learned about PhysTEC and experienced the driving vision of Ted Hodapp, APS's Director of Education and Diversity. He energetically described how APS, working with AAPT, would address the nation's need for well-prepared physics teachers by igniting action in physics departments. He told me of my association's important role to develop the support of university leaders for the ongoing initiative in physics and also to stimulate similar action by other university STEM departments. We discussed how APLU might craft a role complementary and supportive to that of APS.

The time was right for this idea, and our ad-hoc commission came to the same conclusion as Hodapp – that APLU should create a way to stimulate university presidents and provosts to commit to action to increase the supply and improve the preparation of science and mathematics teachers. They recognized that while faculty provide the instruction and run programs, universities needed to provide supportive institutional environments, including policies, organization, resources, recognition, and rewards. Therein was the genesis of SMTI.

With an initial surge to 100 committed institutions, today the presidents and provosts of 125 major public institutions (including top research institutions and those serving urban, rural and minority populations), along with 12 university systems across 43 states, have committed to SMTI. These institutions prepare some 8000 science and mathematics teachers annually, making SMTI the nation's largest STEM teacher preparation initiative.

In physics teacher preparation, SMTI institutions are increasingly important. Currently, they produce almost 20% of all new physics teachers annually and perhaps up to half of the best-prepared ones. (Unfortunately, due to differences in state certification definitions for physics teachers, it's not a simple matter to derive a more precise number.) Over half of SMTI institutions are PhysTEC members – and constitute some 30% of PhysTEC's 222 member institutions. On these campuses there is focused effort to prepare more well-prepared teachers using PhysTEC's strategies, which include, among other things, using master teachers to develop bridges between physics departments, schools of education, and local K-12 school districts; and transforming content and pedagogy courses for future physics and physical science teachers to promote learning through interactive engagement. APLU will work to increase SMTI institutions' membership in PhysTEC.

SMTI leverages regularly scheduled meetings and communications with APLU groups to engage the leadership of institutions to stimulate them to act. Preceding our official launch in 2008, the Chancellor of the University System of Maryland got the focused attention of an APLU Council of Presidents meeting as he was first to announce that his system would triple the number of science and mathematics teachers prepared. Since then, fifty institutions and two systems have signed on to double the number of science and mathematics teachers they prepare. We also collect annual data on the teachers prepared, by discipline, by each institution. (See www.teacher-imperative.org)

Sharing Information

While galvanizing our presidents and provosts is important, it is only part of the equation – presidents and provosts do not teach students. As an organization that deals primarily with leaders in higher education, APLU did not have a mechanism for direct interactions with faculty in member institutions. So our concept was to build relationships with disciplinary and education faculty in two major ways. First, presidents or provosts designate a primary campus liaison to SMTI, thus officially sanctioning SMTI on each campus. Second, SMTI works closely with disciplinary societies – beginning with the American Physical Society (APS) and the American Chemical Society (ACS) – to engage faculty in strategic discussions about improving science teacher preparation. As we identify models of methods to support communication on campus among faculty and administrative leaders, we communicate them to our member institutions. SMTI has become a regular participant at PhysTEC meetings, where we organize an increasingly popular annual session called "A Provost, a Dean and Chair discuss physics teacher preparation." Within APLU, we frequently highlight the work of individual institutions and the progress of SMTI during meeting sessions.

SMTI also serves our community in many quiet ways, including creating strategic communications opportunities between senior administrators and STEM faculty involved in teacher preparation. For example, an urban university president was getting ready to welcome a SMTI meeting on his campus. When I mentioned all the good work of PhysTEC, he asked his provost, who was standing nearby, "Do we have one of them?" This question provided a perfect opportunity to pull the PhysTEC faculty PI into the conversation, giving him a chance – repeated many times since – to give his president an update on what they were doing and how it worked with local schools.

APLU institutions, especially those already committed to SMTI, already participate in numerous programs aimed at producing STEM teachers. But we found a big challenge in the university programs: there was hardly any cross-institutional communication to compare programs, foster improvement and stimulate attention to increasing the numbers and quality of teachers prepared. There wasn't a convener across universities like PhysTEC does across physics departments. To address this, SMTI's mission is to galvanize university leadership and focus the multitude of institutions (and their programs) toward becoming a community in which education and science and mathematics faculty gain more visibility for their critical teaching efforts, and they share practices, innovations and challenges across their various program approaches. To make this happen, SMTI began convening annual meetings of member faculty and university leaders. Sessions include invited keynotes as well as selected panel presentations. Through an NSF-supported RETA grant entitled *Promoting Institutional Change to Strengthen Science Teacher Preparation* (under the Math and Science Partnership program), SMTI is providing a pilot study of how institutional change depends both on top leadership commitment and faculty ownership of the actions. SMTI is focusing on top leadership commitment; the faculty ownership part of the project is being conducted through collaboration with PhysTEC and the American Chemical Society, to build support for the creation of the Chemistry Teacher Education Coalition (CTEC) – a chemistry equivalent of PhysTEC.

Moving Forward: A Focus on Both Quantity and Quality

Now that SMTI has gained the commitment of university leaders to increase the quantity of science and mathematics teachers, we have begun a complementary focus on improving the quality of teacher preparation programs. With our "Analytic Framework" (AF) we have created – for the first time – a unique common taxonomy of attributes for science and mathematics teacher preparation programs. The AF is being developed as a mechanism to assess individual programs and to benchmark programs against promising practices in teacher preparation across a university system or region, or against national initiatives. We developed this teacher program assessment tool over the past several years from hundreds of hours of site visits, focus groups, and literature review. The AF has been extensively validated through comparisons with major programs such as UTeach, through comparison with national report recommendations, and through testing in individual institutions and across programs in a state. SMTI is also piloting a peer-reviewed system of identifying "promising practices" in components or entire programs of science and mathematics teacher preparation. During the next few years, we plan to administer the AF to institutions and systems, and provide the technical assistance necessary for them to identify and implement program improvements.

As a follow-on activity, this fall, we are launching a three-stage effort to identify quality parameters of science and mathematics teacher preparation programs. First, we will conduct interviews and focus groups of experts in disciplinary teacher preparation. In physics we will draw on the 2010 APS Report synopsis of the "National Task Force on Teacher Education in Physics," and we will involve individuals who served on that task force and in discussions within APS on the quality of physics teaching. Second, we will commission papers on the best practices in the preparation of teachers generally, and on the preparation of science and mathematics teachers specifically. Third, in spring 2012, we will hold a small workshop of experts to discuss what constitutes effectiveness in science and mathematics teacher preparation. The result will be our best sense of quality science and mathematics teacher preparation today to contribute to the national discussion and will also inform the ongoing improvement of the AF.

Forum on Common Core State Standards and Teacher Preparation

SMTI has begun work on the role of higher education in preparing teachers to teach the common core state standards in mathematics and the next generation science standards. The states' adoption of common standards offers perhaps our best opportunity to boost the capacity of science and mathematics teachers to work consistently across states.

We are in the early stages of a project to develop model programs to prepare mathematics teachers for the more rigorous demands of the common core state standards for mathematics. During SMTI's annual meeting last June, several faculty members launched this urgent effort for pre-service programs, as the mathematics standards are beginning to be put in place by states. We have enlisted some of the leading mathematics faculty and leaders of mathematics education programs to participate in a variety of ways – on our advisory board, planning committee, etc. This effort complements work already underway by mathematics professional societies, such as the Conference Board on the Mathematical Sciences, to provide professional development of in-service teachers.

Focusing on science, SMTI is convening an exploratory meeting in September to engage disciplinary societies in the ambitious transformational vision of the NRC's recent Framework for K-12 Science Education. Participants are from NRC (including Dr. Helen Quinn, chair of the effort), Achieve, AAAS, NSTA and the societies representing the 4 major disciplinary clusters contained in that report. The discussion will focus on science teacher quality and preparation in the era of the next generation of science standards. Although new science standards will not emerge for a year or so, it is not too early to engage the higher education and science community in discussions about key aspects of the framework, e.g., how to prepare teachers around science and engineering practices and cross-cutting concepts.

Common Vision, Commitment, and Collective Action

We at APLU continue to seek ideas and opportunities to more fully contribute to national efforts as this evolution toward greater attention to teaching and learning continues. How might APLU help, for example, by 1) supporting faculty, perhaps by serving as a platform for collective action around important educational issues; 2) enabling other collaborations to occur, such as the effort across universities to improve mathematics teacher preparation; or 3) incubating groups from various universities to pursue development or demonstration projects, and then provide opportunities to convey their findings to a larger community of faculty and university leaders. We welcome your input on these and other ideas.

I close with some observations of admirable practices by faculty, as I have learned from SMTI and society meetings.

- Attend PhysTEC meetings to take advantage of sharing experiences, and research on learning and promising practices;
- Identify attributes of model programs (such as the Learning Assistants program begun by University of Colorado, Boulder, now promoted as part of PhysTEC); and consider their fit with your existing effort;
- If you are a more senior faculty member with some standing in your department, provide younger faculty with encouragement, guidance, support and recognition;
- Build a larger critical mass of science faculty engaged in research on teaching and research or teacher preparation, and promote the concept of CTEC to colleagues in chemistry;
- Get further blessing from your dean of science for a more strategic, research-based focus on preparing science teachers across your college;
- Seek out education faculty as collaborators, and with them, connections and collaborations with local/regional school systems;
- If your institution or university system is a member of SMTI, identify and contact the institutional liaison and contribute to their campus efforts;

And, perhaps most important of all:

- Become a role model for your own physics students – particularly undergraduates – encouraging those who might be interested in teaching physics and helping them to identify how they might pursue their interest, at whatever education level. Students can't be what they can't see. Programs such as Learning Assistants enable students to develop teaching skills with junior classmates, and check out whether it's something they wish to pursue, all while they assist professors and other students.

Howard Gobstein is Executive Vice President of Research, Innovation and STEM Education at the Association of Public and Land-grant Universities and Co-Director of the Science and Mathematics Teacher Imperative. He has been an avid advocate and analyst of university research and education while serving at APLU, OSTP, Michigan State and University of Michigan, AAU and GAO. Howard would like to thank Donna Gerardi Riordan and Kacy Redd for their assistance in preparing this article.

Call for Nominations: Awards and Fellowships

Larry Woolf

Excellence in Physics Education Award
This award recognizes and honors a team, group of collaborating individuals, or exceptionally a single individual, who has exhibited a sustained commitment to excellence in physics education. The Award consists of $5,000, a certificate citing the achievements of the group or individual, and an allowance for travel expenses to the meeting where the award is presented and the awardees present a talk. The award is given annually. The application deadline is July 1, 2012. Please consider nominating outstanding candidates, including your own group. Details are at:
http://www.aps.org/programs/honors/awards/education.cfm.html and at http://www.aps.org/units/fed/awards/education.cfm.html

Award for Improving Undergraduate Physics Education
This new award, sponsored by the APS Committee on Education, goes to a department or program and recognizes best practices in undergraduate physics education. See
http://www.aps.org/programs/education/undergrad/faculty/award.cfm.html for details. The deadline for nomination is July 15, 2012.

APS Fellowship through the Forum on Education
APS members are eligible for nomination and election to Fellowship. Each FEd nomination is evaluated by the Fellowship committee of the FEd. After review by the APS Fellowship Committee, the successful candidates are elected by APS Council. Fellowship is therefore a distinct honor signifying recognition by one's professional peers. The deadline to submit an application for fellowship nomination is April 1, 2012. Please consider nominating outstanding candidates. Application details are at
http://www.aps.org/programs/honors/fellowships/nominations.cfm.html

Larry Woolf, a physicist at General Atomics, is the Past Chair of the APS Forum on Education.

Conference Announcement: Laboratory Instruction Beyond the First Year

Paul Dolan

The Conference on Laboratory Instruction Beyond the First Year (BFY) will be held at the University of Pennsylvania and Drexel University, July 25-27, 2012. This will be an opportunity for hands-on exposure to an extremely broad smörgåsbord of contemporary instructional labs appropriate to Modern Physics, Electronics, Optics, Advanced Lab courses, as well as key instructional labs in Statistical Physics, Condensed Matter and Materials Physics, Quantum Mechanics, etc. At the same time, the conference will serve as an opportunity to discuss a range of curricular models that allow for enhancement of the undergraduate physics major. More information can be found at http://www.advlab.org/.

Paul Dolan is a physics professor at Northeastern Illinois University

APS Education, Diversity, and Outreach Program Updates

Monica Plisch

PhysTEC
PhysTEC will hold its annual conference in Ontario, California on February 3-4, 2012. The theme for the conference is *New Paradigms for Physics Teacher Education.* This conference is a great way to meet and interact with the leaders in physics teacher education. See www.ptec.org.

Minority Bridge Program
The Minority Bridge Program is an effort of the American Physical Society, working with the broader physics community, to increase over the next decade the fraction of physics PhDs awarded to underrepresented minority (URM) students to 10%, which is the fraction that currently receive physics Bachelor's degrees. We will do this by creating a national network of sustainable research-focused programs that bridge the transition from institutions where URM students receive their undergraduate education to leading research universities. While a number of URM students do make successful transitions into physics PhD programs, graduation data show that the current paradigm of moving students from undergraduate to graduate education fails to include many. This project will establish "Bridge Experiences" at five institutions to help diverse students prepare for and make the transition to doctoral studies in physics. We have brought together Doctoral Granting Institutions (DGIs), Minority Serving Institutions (MSIs), and concerned organizations to inform and help build a national effort that will offer sustainable solutions to improve support, mentoring, and progress monitoring to ensure that students make the transition smoothly and complete their studies.

The APS occupies a unique position in the community to catalyze action and leverage resources to succeed in these goals and to bring about sustainable change in physics graduate education. For more information, visit www.minoritybridgeprogram.com

Physics Careers Webinars
Physics Careers Webinars offer interactive discussion, career guidance, and advice from fellow physicists. Past webinars have included *Physics Careers in Small Companies* and *Choosing a Graduate School in Physics and Related Disciplines*. APS webinars require registration but are always free. For more information, to register for a webinar, or to view past webinars, please go to www.aps.org/careers/guidance/webinars/

Physics Mentoring Seminar
The Physics Research Mentor Training Seminar is a facilitation guide to a training seminar for physics faculty, postdocs, and graduate students who are in mentorship roles. The guide is intended to help physics researchers improve their mentoring skills and to improve the research experiences of the next generation of physicists. To access a free PDF copy of the guide, go to www.aps.org and enter "mentor training" in the search bar. A number of introductory workshops based on the seminar have been organized at APS meetings and other conferences. Please contract Monica Plisch (plisch@aps.org) if you are interested in organizing a workshop at a meeting or conference.

Physics departments threatened with closure
Nearly half of the undergraduate physics departments in Texas are threatened with closure after a decision by the state's Higher Education Coordinating Board to end programs that do not graduate an average of at least 5 students per year. Officials in other states looking for cost-cutting measures are watching Texas, including the Florida governor, who has publicly expressed interest in similar measures. APS is working on coordinating a response, noting that if such policies spread, 57% of all physics departments at public institutions would be at risk. In addition, there would be disproportionate negative impact on institutions that serve minorities, including the closure of physics departments at all public historically black colleges and universities.

Monica Plisch is Assistant Director of Education at the American Physical Society and co-PI on the Physics Teacher Education Coalition (PhysTEC) project.

APS Spring Meetings Preview: Forum on Education Sessions

Renee Diehl

The Forum on Education has a wide range of exciting sessions planned for the March and April 2012 APS meetings, to be held in Boston and Atlanta, respectively. The meetings are somewhat unusual this year in that the March meeting starts in February and the April meeting starts in March!

Here we present some highlights of the March meeting sessions being organized by the Forum.

K-12 Science Education: Closing the Gap with the Leading Nations

This invited session will open with Helen Quinn, a Stanford theoretical particle physicist and member of the National Academy of Sciences who serves on numerous boards and committees studying physics education. She will speak about a new report from a committee she chaired at the National Academy, "A Framework for K-12 Science Education," which identifies the key concepts, ideas and practices that students should learn by the time they finish high school. Other speakers in the session are George deBoer from AAAS, who will speak about "The Globalization of Science Education," Arthur Eisenkraft from University of Massachusetts, who will talk about "Physics For All," Gay Stewart from the University of Arkansas and Vice President of AAPT, who will discuss the overhaul of AP algebra-based physics, and Philip Sadler from the Harvard-Smithsonian Center for Astrophysics, who will present findings on "The Role of Pre-College Preparation in College Physics Success."

Photo by Dann Quinn

Helen Quinn

K-12 STEM Outreach to Underrepresented Communities

This invited session, co-sponsored by the APS Committee on Minorities and the Committee on the Status of Women in Physics, features programs that help K-12 teachers enrich the in-class STEM experience, and after-school programs that provide enrichment not possible in the classroom. Programs successful in attracting underrepresented populations to STEM fields will be discussed by five speakers with proven track records in this arena.

Scientific Reasoning in a Physics Course

This invited session contains reports on various aspects of student reasoning in undergraduate physics by leading researchers in the field of Physics Education.

Using the Technologies of Astronomy to Teach Physics

This session features five speakers with first-hand knowledge of the development or use of astronomy's technologies such as CCD cameras, adaptive optics, high resolution spectroscopy, or other remarkable detectors developed to make astronomical observations in the infrared, millimeter, x-ray, and gamma-ray parts of the spectrum. They will describe the technologies and their basic physics, describe their impact on astronomy, and point out ways physics instructors might use descriptions of the technologies as contexts for teaching physics ideas and principles to undergraduate physics students. The goal of this session is similar to that of the 2012 Gordon Research Conference: Physics Research & Education, which has as its central theme "Astronomy's Discoveries & Physics Education." For more details go to the URLs http://betterphysics.org and http://www.grc.org/programs.aspx?year=2012&program=physres. Peter Shaffer and Charles H. Holbrow are co-chairs of this Gordon Research Conference.

Other sessions of interest to physics educators and students

Entrepreneurship is the topic of an invited session organized in co-operation with the Forum on Graduate Student Affairs. A fact that is rarely communicated clearly to graduate students in physics is that businesses with fewer than 100 employees represent over 99.7% of all employers and employ some 50% of the total US workforce, providing 60-80% of net new jobs annually. An early-stage company can offer an exciting environment for directed scientific research, for technology innovation, and for career progression. This symposium is crafted to convey the excitement and the challenges involved in launching and driving the early growth of a new technology company. The invited speakers, luminaries in entrepreneurship, will share entrepreneurial experiences, highlighting factors involved in transitioning a research innovation towards real business potential.

Also of interest to graduate students and early-career physicists, an invited session organized jointly with the APS Topical Group on Quantum Information will highlight liberal arts colleges as potential career choices for quantum information scientists.

Finally, two focus sessions, consisting mainly of contributed papers, have been proposed (http://www.aps.org/meetings/march/scientific/focus3.cfm.html – scroll to bottom of page). The first, *Research Collaboration Between Mentors and Undergraduate Students*, has an unusual format, because each submission requires two abstracts, one from an advisor and one from an undergraduate student. It provides a setting for coupled presentations by faculty-student pairs. The expectation is that the faculty member will provide the broader physics background of an undergraduate research area, and convey how undergraduate students have profitably worked within it. The student presenter will describe the results of the research completed while being mentored by the

faculty member. The second focus session, *Students, Physics and Innovation*, has a goal of developing a community of APS members interested in connecting curriculum with experiences in innovation and entrepreneurship. Doug Arion from Carthage College will kick off this session with an invited presentation "Physicists and Economic Growth: Preparing the Next Generation."

Renee Diehl, a physics professor at Penn State University, is Chair-Elect of the APS Forum on Education

Web Watch

Carl Mungan

I'll start this issue's column with a focus on web pages devoted to STEM (Science, Technology, Engineering, and Mathematics) education:

- Britain's STEM Network at http://stemnet.org.uk/
- PBS's STEM resources at http://www.pbs.org/teachers/stem/
- Gifted Children's STEM page at http://www.nagc.org/index.aspx?id=1484
- STEM for students with disabilities at http://www.washington.edu/doit/Stem/
- DOE's Office of Vocational & Adult Ed STEM page at http://www.stemtransitions.org/
- Tennessee Dept of Ed STEM resources at http://www.stemresources.com/
- NASA's page on STEM careers at http://stemcareer.com/
- National Institute for Science Ed's homepage at http://www.wcer.wisc.edu/archive/cl1/
- Institute for the Study of Knowledge Management in Education's STEM Learn and Earn site at http://www.completionmatters.org/summary/STEM%20Learn%20and%20Earn

- The NSF funded center for case study teaching in science has a searchable online collection at http://sciencecases.lib.buffalo.edu/cs/collection/.

- My students rave about how easy it is to quickly do math stuff at http://www.wolframalpha.com/.

- A large collection of useful physics simulations and explanations organized by topic can be perused at http://www.collegeonline.org/library/articles/physics-professor-resources.html.

- A compendium of physics lecture demonstrations can be found at Harvard University's site starting at http://sciencedemonstrations.fas.harvard.edu/.

- A variety of science videos are online at http://www.veritasium.com/ although a few are a bit fluffy. Another bunch of physics videos are at http://www.physics.org/article-interact.asp?id=59.

- Haverford College has posted a good bunch of electronics, optics, and quantum laboratory writeups at http://www.haverford.edu/physics/Amador/AdvancedLabTeachingResources.php.

- Some of your students are probably interested in medical physics. The American Association of Physicists in Medicine has a page of links at http://www.aapm.org/links/medphys/.

- NASA's Messenger spacecraft is currently orbiting the planet Mercury. View images and learn about its mission at http://messenger.jhuapl.edu/index.php.

- AIP is attempting to increase science news content in syndicated media. You can visit its news service at http://www.insidescience.org/.

- Alice is a package used to teach computer programming with 3D graphics at http://www.alice.org/.

- I'm starting to hear the term "Problem-Based Learning" more and more often. One resource devoted to the idea can be accessed at http://www.makinglearningreal.org/.

- The textbook "Physics of Light and Optics" is online at http://optics.byu.edu/textbook.aspx.

Carl Mungan, mungan@usna.edu, is a physics professor at the United States Naval Academy

Browsing the Journals

Carl Mungan <mungan@usna.edu>

- Rod Cross has an article in the October 2011 issue of *The Physics Teacher* (http://scitation.aip.org/tpt/) concerning what happens to a car when it drives off the end of a ramp. After the front wheels lose contact but the rear wheels have not, the car will begin to rotate downward about its center of mass. This has real-life implications, as a vehicle that drove off the top of a sand dune in Australia landed nose down and then rolled onto its roof, seriously injuring a passenger. Also the September 2011 article about the "magic trick" of a ring falling and getting knotted in a chain reminded me of the demonstration show at the Summer AAPT meeting about the physics of magic.

- A pair of physicists ask "Is the electrostatic force between a point charge and a neutral metallic object always attractive?" in the August 2011 issue of the *American Journal of Physics* (http://scitation.aip.org/ajp/). Of course, they would not ask unless the answer were no, but you will have to read the article yourself for a specific worked-out example.

- I teach at the U.S. Naval Academy. It's amazing how much the midshipmen love shooting stuff. Read about some video measurements that a student and a military instructor made of a potato bazooka on page 607 of the September 2011 issue of *Physics Education*. The journal can be accessed at http://iopscience.iop.org/journals.

- The same webpage also gives a link to the *European Journal of Physics*. The September 2011 issue has lots of interesting articles: how a reverse sprinkler is related to a putt-putt boat and an unclamped garden hose wildly spraying around on page 1213; video evidence on page 1245 that a piece of paper placed on top of a book and dropped with it is not in free fall; a discussion on page 1293 of why it is difficult to ride a real bicycle on top of rollers; and on page 1367, measurements of axle friction for a rotating disk.

- The June 2011 issue of the *Latin-American Journal of Physics Education* (http://www.lajpe.org/) has a paper comparing series and parallel networks of Atwood machines to familiar resistor circuits.

- The July 2011 issue of the *Journal of Chemical Education* (http://pubs.acs.org/toc/jceda8/88/7) has several interesting pieces: some thermodynamic measurements of cups of water using an infrared camera on page 881; examples of using computer software to calculate propagated errors on page 916; and use of atomic units on page 921.

- The Fall 2010 issue of the *International Commission on Physics Education Newsletters* leads off with an overview of ComPADRE by Bruce Mason at http://web.phys.ksu.edu/icpe/Newsletters/news.htm.

- Finally, APS's Spotlight (http://physics.aps.org/) recently highlighted an article entitled "Strongly Modified Spontaneous Emission Rates in Diamond-Structured Photonic Crystals" in *Physical Review Letters* that succeeds in demonstrating a greater than one order of magnitude reduction in spontaneous emission of quantum dots embedded in a three-dimensional photonic bandgap structure.

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