



Forum on Education

American Physical Society

Fall 2013 Newsletter

Beth Lindsey, Editor

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From the Chair

Paul Cottle, Florida State University

If you are looking for reasons to be encouraged about the future of physics education, find some great physics instructors and feed off of their passion. Some members of the APS Committee on Education and staff members of the society's Education and Diversity Department did just that recently, courtesy of Chicago State Physics Professor Mel Sabella, who is a member of our Forum's Executive Committee and the society's Committee on Minorities. Mel, working with his colleagues at Harold Washington college, Anthony Escudero, Jaime Millan, and Phillip Vargas, set up two meetings for the COE members, one with a group of high school physics teachers he works with at Chicago State, and another with physics faculty from several institutions in the city's system of two-year colleges.

The physics teachers came from a variety of backgrounds – through traditional teacher education programs, alternative certification and Teach for America. They teach at magnet schools, charter schools and traditional schools. What they have in common is that they are passionate, smart, and determined, and that they have been energized through their professional development work with Sabella and others at Chicago State.

Physics – and more generally science – seems to be of central importance in Chicago's public schools. For those of us from parts of the nation where these subjects do not hold such privileged places, it was like visiting an oasis. The teachers talked about how Chicago's colleges and universities (including Sabella's Chicago State) work extensively with the public schools on improving science instruction. They mentioned the influence of Leon Lederman, the Nobel Laureate, former Director of Fermilab, education activist and now Pritzker Professor of Physics at the Illinois Institute of Technology.

But teaching in an urban environment – and perhaps particularly teaching physics in an urban environment – is incredibly demanding work. At FSU, I once served on the doctoral committee of science education student Rowhea Elmesky, who is now on the education faculty at Washington University at St. Louis. Elmesky's dissertation work, which was guided by Ken Tobin (now Presidential Professor at CUNY) involved teaching physics to students at an inner city high school in Philadelphia. As part of the supervi-

sion of this work, we viewed videos of Elmesky's teaching. The scenes from those videos are burned into my mind, and I have tremendous admiration for teachers with the courage to help their students achieve in such environments.

The Chicago City College faculty we met with talked about the challenges of working with students who themselves have extensive obligations with work and family outside of the classroom. They also described how their teaching had evolved to meet the needs of these students. This process was helped along by a major project to renovate physics classrooms into studio configurations at all of the colleges. The room in which we met at Harold Washington College downtown is one of those renovated classrooms, and it is a terrific facility. Great faculty with great support from college administration – that is a recipe for student achievement that we all recognize.

The high school and two-year college faculty we met with work with many students from low-income backgrounds. A great deal depends on the success of these students – for our fields of physics and engineering, for society, and for the students themselves. For our fields, these students are our best hope for a more diverse workforce in which we finally overcome the severe underrepresentation of certain minority groups. For society, the success of these students will dramatically expand the supply of scientific and technological leaders. And for these students, careers in engineering and the physical sciences are the best opportunities for upward economic mobility in an increasingly difficult employment marketplace. To a large extent, the future depends on the work of the faculty we met in Chicago – and others like them throughout the nation.

Paul Cottle is the Steve Edwards Professor of Physics at Florida State University and the current chair of the Forum on Education. He also serves as the chair of the APS Committee on Education (COE). He was recently elected a Fellow of the APS. Paul conducts research in experimental nuclear physics, and is active in precollege science teacher preparation. He is an advocate for effective standards for STEM education in his home state of Florida and nationally.

Letter from the Editor

Beth Lindsey, Penn State Greater Allegheny

In June of 2013, 60 members of the Physics Education Research (PER) community gathered at the College of the Atlantic in Bar Harbor, Maine, for the 5th biennial “Foundations and Frontiers in Physics Education Research” (FFPER) conference. First held in 2005, and modeled after the Gordon Conferences, this meeting is a “venue for specialists who are active researchers in the field of physics education.” Talks at the conference are all in a plenary format, typically addressing the speaker’s take on the major accomplishments of the field of PER (Foundations) or describing possibly promising research directions (Frontiers). This year, the plenaries included talks by Steve Kanim (New Mexico State University), David Meltzer (Arizona State University), Laurence Viennot (Université Paris Diderot-Paris 7), Noah Podolefsky (University of Colorado-Boulder), Eleanor Sayre (Kansas State University), Steve Pollock (University of Colorado-Boulder), Suzanne Brahmia (Rutgers University), Mila Kryjevskaja (North Dakota State University), and Charles Henderson (Western Michigan University). The plenary sessions are followed by coffee breaks and discussion sessions in which attendees engage deeply with the speakers and with each other.

Afternoons at the conference are spent in smaller sessions. In the past, these sessions have taken the form of Working Groups (addressing current issues in PER as identified by the conference organizers) and Targeted Sessions (exploring specific research topics). This year, the working groups were self-organizing: Conference attendees identified topics of mutual interest and formed

collaborative groups to discuss or otherwise engage with these issues. One working group this year addressed some of the goals and possible activities for the new APS Topical Group in Physics Education Research. Another addressed Diversity issues in physics and in PER. Both of these working groups produced reports that are included in this newsletter.

Another novel feature of the 2013 conference was the Graduate Research Symposium. Modeled after graduate schools in Europe, the symposium gave graduate students the opportunity to share their research with one another and with faculty mentors. In this newsletter, Abigail Daane and Paula Heron share their experiences of the symposium from the perspective of graduate student and faculty mentor, respectively.

The FFPER continues to exist and flourish in part because of the financial support of the Forum on Education, and I believe that I speak for all of the conference attendees in my gratitude for that support. As a member of the PER community, I value the FFPER as a space in which to immerse myself in current research and to form connections and collaborations with other members of the community.

Beth Lindsey is an Assistant Professor of Physics at Penn State Greater Allegheny, outside of Pittsburgh. She conducts research in Physics Education, with a particular emphasis on student understanding of energy at the introductory level.

FEEd-sponsored Sessions for the 2014 March and April meetings

Michael Fauerbach

The Forum on Education will sponsor a variety of interesting sessions during the March and April 2014 national meetings. Below you will find a brief summary of the sessions sponsored during the meetings. Hopefully, many of our members – and future members – will find the time to participate in these stimulating talks and participate in lively discussion after the talks.

March Meeting

One of the sessions during the March meeting is a continuation and expansion of the 2nd Graduate Education Conference. After an overview of the previous conference, talks will tackle such issues as access to graduate schools for diverse students, the varying curricula and exam structures among graduate schools, the varying admissions processes, as well as non-academic careers.

In the past many sessions dealt with pipeline issues – how do we get students interest in STEM, specifically physics? This time we will sponsor a session that will deal with the ‘leaky’ pipeline we face in physics. Why do students start out as physics majors, but do not graduate? What are the influences on students’ experiences at critical transition points where they can either begin to feel more or less part of the physics community, such as their freshman year in college or the transition to physics graduate school? These talks will help us understand what is most critical at these junctures from a variety of perspectives (including those of related disciplines) as well as providing some practical strategies.

Also at the Denver meeting we have a PER-related session on research-based assessments. These assessments have been created and validated for many physics topics, and for student abilities and beliefs, but it is often unclear how to best use these assessments and interpret the results. In this session we discuss the creation, research validation and best uses for these types of assessments. We will highlight research-based assessments for upper division courses, assessments of student scientific abilities and new online guides to assessment as well as a national database of research-based assessment results and an accompanying data explorer. We also discuss research on how faculty and institutions differ in their views of best practices for assessing students. This session is aimed at helping instructors access and use research-based assessments most effectively.

Our final sponsored session in March will be the inaugural Jonathan Reichert and Barbara Wolff-Reichert Award for Excellence in

Advanced Laboratory Instruction. The award winner, Gabe Spalding from Illinois Wesleyan University, will present in this session that overall focuses on how we can prepare students for the transition from instructional to research lab.

April Meeting

We will host five invited sessions during the April meeting in Savannah, GA.

One session will deal with Makerspaces and open innovation laboratories for independent, undergraduate research, which have become quite popular lately. These are also often a place where students can be introduced to and gain first-hand experience in entrepreneurship.

Another session in the April meeting will deal with Massively Open Online Courses (MOOCs). These courses are providing students with new opportunities to acquire a basic knowledge of physics. While the quality, extent, and longevity of the impacts of these courses remains unclear, it is undeniable that we in physics community should be aware of and understand the benefits and risks associated with this transformative method of instruction.

We will host two sessions in Savannah in conjunction with the AAPT. One session deals with Physics in the Life Sciences, and we have a great cohort of speakers lined up. The other AAPT session is entitled: *Readying Physics Departments to Engage in Teacher Preparation and Course Transformation*.

Finally, the Forum will host a session celebrating the winners of the 2013 Excellence in Physics Education Award: David Hestenes and Jane Jackson (both from ASU), and the American Modeling Teachers Association (AMTA).

Lastly, I would encourage everybody to stop by during the business meeting to chat with members of your executive committee. If you have a time conflict, you will have another opportunity, as we will co-host an evening reception together with Committee on the Status of Women in Physics (CSWP) and Committee On Minorities (COM).

Michael Fauerbach is a Professor of Physics and Astronomy at Florida Gulf Coast University. He is the Chair-Elect of the Forum on Education.

FFPER 2013 Working Group Report: APS Topical Group in Physics Education Research

Rachel E. Scherr, Seattle Pacific University, Monica Plisch, American Physical Society

With the formation of the APS Topical Group in Physics Education Research (GPER), there is an opportunity to build a closer link between the PER community and the broader physics community represented by APS. A working group met to discuss what some specific activities might be that would take advantage of this opportunity. Some of the possibilities discussed were the means by which GPER might advocate for physics education research as a profession; whether there should be a GPER conference; what GPER sessions at APS meetings might consist of; and how GPER might identify physics education research questions of central concern to the broader physics community, for the benefit of both communities. This last issue has evolved into a proposal, reproduced below.

Proposal for Working Group: Grand Challenges in Physics Education

Motivation

A GPER research agenda would provide guidance to physics education researchers and help strengthen proposals. It would also benefit APS efforts to improve education and diversity, as well as initiatives by individual members in these areas.

Charge

A working group will be convened to create a white paper identifying top research questions or “grand challenges” in physics education that are answerable by PER methods. The questions should be of central interest to the broader physics community with potential for significant impact. Alignment with national documents identifying related challenges in STEM education will increase the potential impact. The results should guide ongoing efforts to transform education practices and build a more inclusive community.

Sponsorship/Endorsements

This initiative will be led by GPER, and will seek co-sponsorship or endorsement from the Forum on Education, the Committee on Education, and other APS units as appropriate. AAPT will also be invited as a co-sponsor through PERLOC. The APS Executive Board will be asked to endorse the final report, and the Panel on Public Affairs will be consulted as appropriate.

Membership

The membership of the working group will include society leaders engaged in education and diversity issues, including Forum on Education executive board members, Committee on Education members, and other unit leaders as appropriate. The working group will also include leaders from the PER community including GPER executive board members, as well as ex officio APS staff members. The total membership of the working group will be 10 people.

Activities/Timeframe

The working group will meet twice in person. The goal of the first meeting will be to gather, vet, and formulate a draft list of questions. These questions will then be sent in a survey to FEd and GPER members, as well as members of other units as appropriate, for feedback and suggestions. The working group will meet a second time to review the results of the survey, finalize the list of questions, and begin a draft of the white paper. Other conversations will take place as needed by teleconference or videoconference. After the draft is reviewed by external experts, the white paper will be finalized. It will take approximately one year to complete the project.

Dissemination

The research agenda will be made available on aps.org. It will also be printed and distributed to all GPER members, and a report will be made to the GPER executive board. In addition, the research agenda will be presented at a conference attended by the PER community. The research agenda will also serve as a basis for discussions between APS and the NSF.

Rachel Scherr is a Senior Research Scientist at Seattle Pacific University, where she serves as Co-Principal Investigator for the SPU Energy Project and the Video Resource for Professional Development of University Physics Educators. She is one of the co-organizers of the FFPER conference.

Monica Plisch is the Associate Director of Education and Diversity at APS. She is the Co-Principal Investigator on the Physics Teacher Education Coalition (PhysTEC) project and is a member of the program management group for the APS Bridge Program.

FFPER 2013 Working Group Report: Diversity Concerns in Physics

Ximena Cid, University of Washington; Natan Samuels, Florida International University; Kathleen Hinko, University of Colorado-Boulder; Brandon Lunk, Elon University; Ayush Gupta, University of Maryland, College Park

At the Foundations and Frontiers of Physics Education Research (FFPER) conference held in Bar Harbor, Maine, June 17 – 21, 2013, a working group of about 12 women and men of a variety of ages, professional levels, nationalities, and ethnicities voluntarily met over the course of three days to discuss diverse participation in the sciences. Concerns about diversity in physics have existed for decades, and in spite of actions being taken, we believe that more needs to be done to broaden participation in the sciences. Diversity issues related to people's backgrounds and cultural associations are highly complex and include, but are not limited to, categories of: nationality, ethnicity, gender, sexual orientation, socioeconomic status, regional demographics, etc., as others in our community have described [See the June/July 2007 issue of *Interactions across physics and education*, (publisher: American Association of Physics Teachers), focused on diversity across physics.]. In its most simplified form, however, the overarching problem that we face in the physics community is a *lack* of diversity.

After fruitful and illuminating discussions, we decided to divide into two subgroups: One subgroup (Allie, Blue, Robertson, Sawtelle, and Traxler) was to produce a resource letter that synthesizes the work on diversity done in various fields, for ease of access to physicists; the other subgroup (Cid, Gupta, Hinko, Lunk, and Samuels) would produce a position paper (this document) on current concerns about diversity in physics. These two documents would complement and strengthen each other. For the remaining manuscript, “we” often refers to the members of the subgroup that produced this document; at times, it refers to the community of physicists, of which we are a part.

Within the broader physics community, we identified three subpopulations characterized by similar, yet distinct sets of goals, practices, and cultural norms and thus distinct issues concerning diversity: Physicists, Physics Educators, and Physics Education Researchers. These three groups are interrelated, overlapping, and codependent; however, making these distinctions can help us address the ramifications that diversity issues have in each population. In order to focus on how these issues are currently playing out within each population, we considered three questions: 1) What are the diversity issues related to each group? 2) What is problematic or a cause for concern about these issues? 3) What can be done to address these issues, and thus promote change in the physics community? We consider the overlapping populations along with the responses to these questions to be features of a diversity landscape for the physics community. For this paper, we limit our discussions to diversity issues related to the traditional physicist population (attending to their roles both as researchers and research mentors).

Why is the lack of diversity a serious problem for physicists? The short answer is that the lack of diversity of the population leads to

a lack of diverse ideas. Undergraduate physics majors and graduate students in physics are encouraged to engage in diverse research experiences, work with a plurality of research mentors, and pursue graduate studies or postdoctoral appointments at institutions different from where they got their previous degree. Ideally, this would enable these young physicists to gain a variety of experiences that could stimulate flexible thinking, promote the use of multiple perspectives, and prevent the intellectual stagnation of considering only singular ideas or methodologies. We believe that the lack of diversity within our own field (with respect to gender, ethnicity, and socioeconomic status) also has the potential to engender intellectual stagnation. By habitually attracting and accepting similar pools of applicants (which can tacitly discourage future scientists who are different along some of these dimensions), we severely limit our ability to develop and progress as a field. Physics departments also want to recruit and retain the most skillful and talented people. A sustainable culture of research requires a multiplicity of people's wisdom and experience; a state that is difficult to attain in a homogeneous group. If we, as a community, are concerned about the diversity of ideas in undergraduate and graduate education, then it is fundamentally imperative that we consider the diversity of the population of physics students itself. Instead of dismissing this lack of diversity as emerging solely from a limited applicant pool, we encourage our colleagues to ask why is it that the application pool is limited in the first place? Linking physicists to physics educators and education researchers, this question speaks to the urgent need to bolster support at all educational levels so that students from all backgrounds can feel encouraged to pursue roles within scientific and physics communities.

Our purpose in writing this article is not to chastise, but to encourage and urge more communications and action. As such, we acknowledge that many physicists (and their institutions) do indeed care about these issues, and have taken steps to address them. Yet for many [of us?], this may seem daunting. Therefore we have tried to articulate our perspective on some aspects of the nature of the diversity concerns in physics and some potentially actionable steps.

It can be easy to think, “if I can succeed in physics, so can anyone.” However, the idea that hard work is sufficient for guaranteeing success (the Horatio Alger myth) assumes that everyone shares the same cultural experiences. Indeed, it can be difficult to relate to the challenges that individuals from underrepresented groups face throughout their pursuit of education. Have you ever been the only woman in a class of men or the only underrepresented minority in a class of white middle class students? For some of us, this scenario may be very difficult, if not impossible, to relate to – that is, unless we imagine a different world. What would it feel like to be the only white person in a class of all Latino students or the

only male in a room of female colleagues? Furthermore, consider what it would be like to take a course in which society expects your cultural or socioeconomic group to underperform – and for you to be aware of that stereotype. These are probing questions, but as we are trained as physicists, not social scientists, the idea of “community” lies outside of our expertise. How are we to change the culture of physics if, as individuals, we do not feel comfortable with or understand how to approach the problem?

What steps can be taken to address these issues? We think that the first step is to create a personal connection to the problem of diversity. Unless people have personal connections with understanding diversity, then it is very unlikely that this issue will appear on their everyday agenda. We can each start with small steps and small reflections: what connections do we see in our circle that have issues with diversity? What population of students are most prevalent in our own institution? What kind of posters line the hallways in our department; do any of them have representations of diversity? Simple visual cues can also have subtle impacts on the welcoming environment to students. Understanding where our students are coming from is vital in understanding how we can improve the physics cultural environment.

It is to the benefit of the physics community that we help our students grow and develop into contributing members, regardless of their backgrounds. Every person has a history and challenges that are uniquely their own. Maybe the very notion of categorizing via demographics and the stereotypes that come with that (even well-intentioned) could be harmful. Those who have made it to a physics undergraduate program have had enough motivation and desire to explore physics in the first place and should not be isolated simply because they belong to a specific demographic.

An alternative would be to try to understand individuals (students and/or colleagues) without making a priori assumptions about their experiences or needs based on their visible gender/ethnic identity. For example, the black student need not necessarily be “at-risk” or need remedial instruction. If a student needs help, they should have the option of asking for it (and receiving it) instead of it being forced upon them. This point is not to suggest that at-risk students should be ignored, it simply means that we should acknowledge that they are already well aware of their differences. And, of course, there is the more complex topic of the tacit value structures of society that are built into what we recognize as successful, and how we measure “at-risk.” More often than not, students have much more to offer than can be measured by standardized tests and even prior course grades.

Who is responsible in our community for addressing diversity issues? Our answer is that all of us can make at least small changes for the betterment of our community and our field. While the biggest efforts towards improving diversity may come from senior members of departments or labs, junior members, including faculty, postdocs, research scientists and graduate students, can and do deal with diversity as part of their professional activities. If, as a physicist, you hire researchers, mentor students, interact with colleagues, serve on committees, participate in outreach, or teach classes, diversity issues are present.

We believe that individual faculty members can have a significant impact. As physicists, we can strive to connect our research to larger social relevance and to ideas/topics relevant to diverse communities. Consider your mentoring activities: have you made connections with a local high school to help broaden the impression of what it means to be physicists? Do you encourage openness to ideas in your group meetings, and is there a safe space for members to ask critical questions? If on an admission committee, how could you consider candidates as potential researchers/teachers/colleagues instead of primarily focusing on their SAT or GRE scores?

Finally, as part of making first steps, we consider: Is there a way to expose ourselves to different types of environments, cultural practices, etc.? Exposure is a powerful tool in creating a personal connection.

The takeaway message for our community is that we need to incorporate the human aspect into the practices of physics. We should talk to students about who they are as a person instead of simply what they know as an entity. We, the physics community, should be concerned not only with the broader impact clauses included in our grants, but with creating a new generation of physicists that represent the diverse populations that surround us in the world at large.

Finally, the body of work that tries to understand, dissect, and investigate the diversity issues within science is growing. The AJP Resource Letter on this topic (in preparation by the other subgroup of this working group) will be a good starting point for an interested physicist. Please look for it in the coming year.

Members of the “Diversity in Physics” working group included Saalih Allie, Jennifer Blue, Amy Robertson, Vashti Sawtelle, and Adrienne Traxler, in addition to Ximena Cid, Natan Samuels, Kathleen Hinko, Brandon Lunk, and Ayush Gupta.

Upcoming Conferences

2014
PhysTEC
Conference



May 19-20, 2014

University of Texas at Austin

The PhysTEC conference is the nation's largest meeting for physics teacher education. The conference, held in conjunction with the 2014 UTeach Annual Conference, will feature workshops, presentations by national leaders, and excellent networking opportunities.



Building Leadership



<http://www.ptec.org/conferences/2014/>

Redesigning the Physicist: Physics Innovation and Entrepreneurship Education for the 21st Century

June 5 - 6, 2014
 College Park, MD

We live in an era of immense opportunity for physics graduates: their scientific training helps to make them key members of industry teams developing new technologies, or translating cutting-edge research into viable products. The future of the physics discipline depends on implementing new approaches which provide training for success in what is increasingly the largest employment base for physicists: the private sector.

APS is holding a conference for physics department leaders, targeted at developing physics innovation and entrepreneurship (PIE) programs at their institutions. Sessions will feature programs which have successfully implemented PIE components, as well as "success stories" of graduates from these programs. They will also feature information about resources, including organizations like the National Collegiate Innovators and Inventors Alliance (NCIIA), which offer funding, guidance, and access to a community of practitioners.

www.aps.org/programs/education/conferences/innovation.cfm

A Novel Approach to Promoting Graduate Student Professional Development: The First Graduate Research Symposium at FFER

Abigail Daane, Seattle Pacific University and Paula Heron, University of Washington

Graduate students have always been an important part of the FFER Conference series. At each conference since 2005, student participation has been supported by grants from the APS Forum on Education, which has allowed them to pay reduced registration fees. At the fifth FFER conference, a special Graduate Symposium was held to allow students to present their own work and have it critiqued by their peers and faculty mentors. The format was based on graduate schools that FFER organizers have attended in Europe. The process was intended to benefit students' thesis research and possibly result in a publishable paper. It was also intended to contribute more generally to their professional development by offering students the opportunity to broaden their knowledge of PER, strengthen their communication skills, develop reviewing skills and get to know their peers.

Each participating student wrote a four-page paper on part of their PhD research, following the format of the Proceedings of the annual Physics Education Research Conference (<http://www.compadre.org/per/perc/Proceedings.cfm>) and submitted it several weeks before the conference. (The PERC format was chosen in part to encourage students to submit their paper to the Proceedings, the deadline for which was shortly after FFER.) The students were placed in three groups, who were mentored by E.F. (Joe) Redish, Rachel Scherr and Paula Heron. Within each group, students reviewed each others' papers. They were instructed to offer constructive advice aimed at strengthening the paper or the work it described, not to judge whether the paper was suitable for publication. In order to facilitate face-to-face discussions at the conference, the reviews were not anonymous. Mentors also provided feedback, either in the form of a separate review, or a cover letter helping the author interpret and prioritize the reviews.

At FFER, each student group had a 90-minute session to present and discuss their work. These sessions were held on different days, to allow students and mentors to attend as many as they chose. During the sessions, each student gave a short oral presentation about his or her work, and then discussed their responses to the reviews they had received. In several cases, there was extensive discussion about how best to incorporate suggestions into the paper. There was also discussion about the review process itself, and what participants learned from the process, both as authors and reviewers.

The faculty mentor view: The faculty mentors all agreed that the reviews produced by the students were of unusually high quality and that the oral sessions were collegial, supportive and productive. Upon reflection, however, there are changes that could be made for future Symposia. For instance, in one group, students were advised to prepare their review as a letter, addressed to the author. There was general agreement that this style led to especially constructive

and helpful reviews. Also, the format for oral sessions was unclear and they were conducted somewhat differently for each group. In particular, there was some discussion about the most useful role for the initial oral presentations, as either a précis of the paper, or a talk aimed at an audience that had not previously read the paper. In the future, the purpose and format of the sessions will be clarified. Finally, at the request of the students, the sessions were not to open to other conference attendees. This decision was discussed extensively. While the students expressed the desire to share their work more broadly, there was also general agreement that having the sessions closed contributed to the relaxed and collegial atmosphere. Overall, the Symposium was successful enough that a larger program will be attempted at a future national meeting.

The graduate student view: Often, learning to write reviews and respond to reviews occur during trial by fire experiences in graduate school. These by-the-seat-of-your-pants moments eventually lead to competency in both reviewing and responding to reviews, but not without struggle. Graduate students who participated in the FFER Graduate Symposium had a chance to learn about the review process in a low-stakes, supportive environment. They first individually wrote a paper and then had the opportunity to read and write constructive reviews of others' papers. These activities alone were good experiences; however, the symposium further supported students, offering an iterative feedback loop. Graduate students received written reviews from other students, then from faculty members, about their papers prior to the symposium. They also received feedback about their own written reviews. Once at the symposium, students were able to share their work with all of the graduate students via a presentation, which gave them the rare opportunity to address, revise, and defend concerns about their writing raised in the reviews *to the reviewers*. The facilitating faculty member encouraged constructive and supportive feedback throughout the experience, reminding reviewers that they would not be anonymous and therefore should approach these reviews as if they were speaking directly to the author. The lack of anonymity created a space for both truth and care. The graduate students could also provide each other with additional constructive feedback in the presentations and throughout the rest of the conference. Because they were able to intimately engage with each others' work and have productive discussions about that work, the experience gave students a strong sense of immediate community throughout the conference.

Abigail Daane is a graduate student at Seattle Pacific University. She conducts research in the context of SPU's Energy Project, investigating K-12 teachers' productive, intuitive ideas about energy degradation and the second law of thermodynamics. She is currently the President of the Physics Education Research Consortium of Graduate Students.

Paula Heron is a professor of physics at the University of Washington, where she is a member of the Physics Education Group. She is a co-organizer of the FFER conference. She has served as a member on the National Research Council's Committee on Un-

dergraduate Physics Education, which in 2013 released the report "Adapting to a Changing World: Challenges and Opportunities in Undergraduate Physics Education."

Browsing the Journals

Carl Mungan, United States Naval Academy, <mungan@usna.edu>

- A comprehensive review of what undergraduate physics majors might need to know about tensors can be found on page 498 of the July 2013 issue of the *American Journal of Physics* (<http://scitation.aip.org/content/aapt/journal/ajp>). It includes discussion of dummy versus free indices, orthonormal bases, div/grad/curl/Laplacian, covariant versus contravariant components, basis transformations, fields, metrics, and Christoffel symbols. In the August issue, I appreciated the article by Paul Withers on page 565 about landing spacecraft on planets, where the drag force varies with altitude in the atmosphere. Descent with and without deployment of multiple parachutes is considered.
- Eric Mazur's group presents data showing that students learn more from lecture demonstrations if they commit themselves to a prediction of the outcome before they see the demonstration performed on page 020113 of *Physical Review Special Topics-Physics Education Research* at <http://prst-per.aps.org/toc/PRSTPER/v9/i2>.
- In the September 2013 issue of *The Physics Teacher* (<http://scitation.aip.org/content/aapt/journal/tpt>), I enjoyed the new editor's Rental Car problem in the box on page 329. (Note however that the graph should be drawn a bit more clearly: Dallas is at $x=0$, the parabola is symmetric about its vertex at $x=250$ km, and Sterlington is at $x=500$ km.) Page 394 of the October issue presents measurements showing that a transverse pulse travels along a hanging cable at a constant acceleration of $g/2$. I have thought about the same setup and discuss a modified wave equation that leads to this value of the acceleration at http://usna.edu/Users/physics/mungan/_files/documents/Scholarship/HangingPulse.pdf.
- One can create impressive sparks by bringing a grounded ball near the top dome of a Van de Graaff generator. An Italian trio of educators show that one can photograph such a spark through a diffraction grating to determine the atomic nitrogen and oxygen ions that compose the spark. Read about it on page 426 of the July 2013 issue of *Physics Education*. I also liked the experiment described in the next article on page 429. Two paddles are mounted on an arm attached to a rotary motion sensor to measure the density of air. An accurate value is found by dropping the prefactor of $C/2$ in the expression for quadratic air resistance, where C is the drag coefficient of the paddles. Although that neglect seems surprising, apparently it implies that C is on the order of 2 for their shape of paddles, at least if one includes the "added mass" effect of an object that is constantly scooping up new air as it rotates. (Recall that the standard formula for quadratic drag assumes an object falling at constant velocity, rather than one that oscillates or rotates.) Brown and Zürcher suggest on page 1095 of the September issue of the *European Journal of Physics* that the hysteresis in the length of duct tape when weights are hung from it could be a good way to introduce biology students to the stress-strain behavior of tendons. I also liked the idea of modeling real-world data, such as Usain Bolt's measured performance in the 100-m dash, by considering both linear and quadratic air drag and the effect of wind on page 1227. Both journals can be accessed at <http://iopscience.iop.org/journals>.
- As a non-chemist, I found helpful the article on page 1003 of the August 2013 issue of the *Journal of Chemical Education* at <http://pubs.acs.org/toc/jceda8/90/8>. It describes how can one construct pyramids out of plastic Lego blocks to describe the arrangement of elements in the periodic table.



Web Watch

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- AAPT's journal *The Physics Teacher* is celebrating its fiftieth anniversary of publication this year. Check out its anniversary booklet in Flash format at <http://aapt.org/Conferences/sm2013/TPT/>.
- The entire three-volume set of *The Feynman Lectures on Physics* have been made freely available in HTML at http://www.feynmanlectures.caltech.edu/I_90.html.
- A good webpage to explore engineering topics ranging from basic to advanced is <http://www.engineeringexchange.com/>.
- Do you remember the Macintosh program called HyperCard? It consisted of virtual cards of information and images. Links between different cards would allow one to browse from topic to topic, finding information of interest. The HyperPhysics web pages, each of which look like roughly letter-sized cards at <http://hyperphysics.phy-astr.gsu.edu/hbase/HFrame.html>, are based on the same idea.
- The electric field created in the wake of a laser pulse passing through and separating charges in a plasma can be used to accelerate electrons to high energies over short distances. The University of Texas at Austin recently achieved a record 2 GeV over a span of 1 inch, as you can read about at <http://www.utexas.edu/news/2013/06/20/particle-accelerator-that-can-fit-on-a-tabletop-opens-new-chapter-for-science-research/>.
- A well-written module encouraging the involvement of undergraduates in research experiences is online at <http://serc.carleton.edu/sp/library/studentresearch/>.
- The American Society for Engineering Education has made its flagship journal *Prism* freely available at www.prism-magazine.org/.
- There has rightly been a huge positive buzz about the a capella YouTube video teaching string theory at <http://www.youtube.com/watch?v=2rjbtX7twc>.
- NASA has a web site devoted to Earth-observing satellites at <http://eosps0.gsfc.nasa.gov/>.
- The University of Nebraska at Lincoln has a set of STEM lesson plans (primarily for middle and high school) available at http://tse.unl.edu/trc/lesson_plans.php.
- I was intrigued by the discussion that nanoscale heat engines are fundamentally less efficient than larger devices because of the breakdown of thermodynamics when applied to systems of few particles at <http://phys.org/news/2013-06-quantum.html>.
- A fun new site for asking and answering unusual pointed questions is <http://www.quora.com/>.
- Nowadays there is a lot of interest in metrics on individual journal articles. You can download a handy browser bookmark tool that will instantly look up citation details for any webpage that includes a Digital Object Identifier for an article at <http://www.altmetric.com/bookmarklet.php>.
- Looking for good background music in your office? I'm partial to Psychedelic Ambient Trance (start at say <http://psy-amb.blogspot.com/2012/>) and to NPR's Echoes at <http://echoes.org/>.
- The Physics Classroom at <http://www.physicsclassroom.com/> is intended to support students and teachers of physics, primarily at the high school level, with tutorials, exercises, and other materials.



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