

PHYSICS OUTREACH & ENGAGEMENT

Letter from the Chair

It has been another exciting year for the Forum on Outreach and Engaging the Public and thanks goes to all the members who have contributed to very successful March and April meetings. We're looking forward to growing on this to even better meetings leading up to the 10th anniversary of the Forum in 2020! Here are some highlights from this year.

1) FOEP sponsored workshop at the APS March Meeting: Finding your scientific voice

Following on the successful FOEP-hosted workshop of last year, we again put on workshops at the APS March Meeting for postdocs and students to improve their communication skills. Two 3-hour workshops allowed participants to learn best practices for communicating scientific results to an audience in the 10 minute talks typically given at the meeting. These workshops also help improve communication to the general public. Given the very positive feedback we received, FOEP intends to sponsor these workshops again at the APS March Meeting and possibly a workshop on written communication at the April meeting.

2) FOEP Invited Speaker sessions at the APS March and April Meetings.

We had exciting and very inspiring talks from leaders in engaging the public from the international to the local scale! Joe Niemala (ICTP) discussed the planning and execution of the International Year of Light celebration. Jorge Cham described the origin of his PhD Comics and web-based comic and video on the discovery of the Higgs Boson. Sam Sampere (Syracuse U.) and Tatiana

Continued on page 2

VOL. 4 NO. 2 SEPTEMBER 2018

In this issue



Letter from the chair
- 1 -



Spotlight on Outreach and
Engaging the Public
- 5 -



Medal and Fellow Nominations
for 2018
- 10 -



FOEP News
(meetings and council report)
- 12 -



Physics at the Movies
- 17 -



Outreach: A Graduate Student's
Perspective
- 19 -



Outreach Resources, and Websites
- 22 -



Funding Information
- 24 -

JOIN US

To join FOEP at no cost prior to renewing your APS membership, send an email to membership@aps.org with your request to add FOEP to your membership. Please note that if you currently belong to two or more forums, FOEP will be added at no charge for the remainder of your membership term. On your next membership renewal notice, you will see a Forum subtotal that will include \$10 for every Forum membership over two.

*A publication of The Forum on Outreach and
Engaging the Public - FOEP -
A forum of the American Physical Society*

Erukhimova (Texas A&M) described building outstanding outreach programs from a university physics department. Clara Moskowitz, Senior Editor for Scientific American, talked about how to publish articles in her iconic magazine. Renee Horton (NASA) discussed how to effectively reach diverse audiences while Lucianne Walkowicz (Adler Planetarium and Library of Congress) presented ways to meet the public in everyday settings for science outreach. Becky Thompson (APS) discussed the amazing efforts of the APS Public Outreach office in producing everything from thousands of school kits to a superheroine comic book.

These invited talks at the March and April meetings provide unmatched opportunities for inspiration and idea-gathering on how to share our scientific journeys with the public. We are always looking for ideas for future speakers, particularly from young scientists who form the largest single component of FOEP membership. We need your input! Please send your suggestions to FOEPAPSnewsletter@gmail.com. **And be sure to check out the FOEP sessions at next year's meetings.**

3) Contributed talks at the March and April meetings

These talks cover the incredible range of outreach practiced by our members that truly show that outreach and engaging the public is for everyone. This year's talks displayed the breadth and diversity of efforts from using historical figures like Marie Curie to inspire STEM interest, to high-end video production inspired by the long-running University of Minnesota Physics Force shows, to examining the intersection between Lakota cosmology and particle physics! Superheroes and music, nanotechnology and physics competitions – the intersections of physics interest and people is staggering and you can hear about them only at the Contributed Talk sessions of FOEP. All of the APS Forum Contributed talks are considered non-technical talks so they can be given in addition to your technical science presentation at the same APS meeting. The Executive Committee strongly encourages you to volunteer to speak and to come to these sessions. Creative ideas can only disseminate if we share our stories.

4) Staged play reading at the March Meeting

As we have in the past, FOEP once again joined with Brian Schwartz

Continued on page 3

Forum on Outreach and Engaging the Public

FOEP's goal is to increase the public's awareness of physics by providing a forum within APS for the large number of physicists currently involved in a diverse array of outreach and public engagement activities. FOEP fosters the development and dissemination of outreach activities such as blogging, multimedia, video, pop culture, popularizations, press relations, politics, "amateur" and distributed science, science cafes, and public shows and lectures. The Forum organizes and sponsors sessions at the March and April APS meetings and will issue a semiannual newsletter.



Larry Gladney,
Univ. of Pennsylvania

Letter from
the Chair,
continued

continued
the Chair
continued

(CUNY) and other APS units (Forum on the History of Physics, Forum on Physics & Society, Committee on the Status of Women in Physics, and the Division of Astrophysics) to sponsor a staged reading of a play for APS members and the general public. This year Brian was joined by Smitha Vishveshwara (University of Illinois) to present a reading of the play *Silent Sky* by the [International City Theatre](#) of Long Beach CA. This play is based on the true story of 19th-century astronomer Henrietta Swan Leavitt and her personal journey at the Harvard Observatory in the early 1900's – a time of history-making scientific ferment but also a time when women's substantial contributions to science were suppressed or overlooked. As per usual, the reading was informative and entertaining and made even more so by the talkback discussion with the play actors and a historian-scientist after the staged reading.

5) Free beer and snacks for FOEP members at the APS Happy Hour hosted by Becky Thompson

Once again, there was great turnout for our Happy Hour at the March meeting. Becky Thompson has been a constant partner to FOEP and a source of energy and imaginative ideas for all the years of FOEP's existence. Please show her your appreciation at one of next year's meetings.

Welcome to our new members and plaudits for our new projects

The Executive Committee works very hard to plan and carry out FOEP programming for the upcoming year. Right now that includes bringing a physical science-based escape room to the 2019 March meeting, new training workshops to the March and April meetings and, of course, talks by leading science communicators. The year 2020 marks the 10th year of FOEP's existence and we are busy planning a huge Pop-up Science Expo event for the March meeting of that year. Planning for a Science Expo is just beginning in earnest. We need your dynamic ideas to make this a memorable and impactful event for APS and the general public in Denver in 2020! Please consider donating time and effort when the general call goes out through this newsletter in the Spring of 2019. Of course we are eager to hear any ideas you have right now.

I want to sincerely thank the current members of FOEP for their efforts in promoting our science and especially to the Executive Committee for several years of personal learning and fun. Now that the election for new ExCom members is complete, I want to welcome them to the fold. Shannon Swilley Greco of the Princeton Plasma Physics Laboratory becomes the Vice Chair of FOEP. Chad Orzel of Union College and Jon Schuller of UC Santa Barbara become the new Members at Large. All three take on their new roles in January 2019. Thanks in advance for the creativity and energy I know you will add!

Finally, the entire Executive Committee wishes to add its sincerest thanks to Itai Cohen and Heide Doss. Itai moves off the Executive Committee at the end of the calendar year. Itai has been not only an effective leader for FOEP, but an inspiring teacher. For the past two years he has run the Finding Your Voice workshops at the March meetings. These have garnered universal comments of praise and thanks from those who have participated. Heide has been a Member at Large and Editor of this newsletter for several years. It's not possible to imagine FOEP without her. While Heide leaves the Member at Large role at the end of the year, we are very fortunate that she will remain in charge of the newsletter for at least another year. She is indispensable. We wish you well Itai and thanks for staying on board Heide!

Continued on page 4

The FOEP Executive Committee members for 2019 will be:

Past Chair: Larry Gladney

Chair: Don Lincoln

Chair-Elect: Jim Kakalios

Vice Chair: Shannon Swilley Greco

Secretary/Treasurer: E. Dan Dahlberg

Members at Large: Shireen Adenwalla, Kathleen Hinko, Chad Orzel, Jon Schuller

FGSA representative: Anashe Bandari

APS Staff member: Rebecca Thompson

Assigned Council Representative: Noah Finkelstein

Editor of the FOEP Newsletter: Heide Doss

Feel free to contact any of us with any suggestions of how FOEP can better serve the cause of outreach!

Larry Gladney

Spotlights on Outreach and Engaging the Public with FOEP's 2017 Dwight Nicholson Award Winner and FOEP's Vice-Chair Elect

Questions and Answers with FOEP's 2017 Nicholson awardee, Neil deGrasse Tyson.

Neil deGrasse Tyson

Hayden Planetarium – American Museum of Natural History

Dr. deGrasse Tyson was awarded the Nicholson Medal for outreach "*for his wide-ranging and awe-inspiring contributions to the public understanding of science, and for his passionate and effective advocacy of the values of critical scientific thinking in a democratic society.*"

Q. What do you find most exciting about outreach? Most rewarding? Most difficult? Most important?

It's a duty. I do outreach not because I want to but because, given the needs of society, I would be irresponsible if I did not. I'd otherwise rather stay home.

I know I have succeeded when people understand an idea or physical concept enough to take ownership of it. At that point, they can have an argument with others that makes no reference to me at all. If they end up saying "This is true because Tyson said so!" then I know I have failed as an educator.

For me the greatest challenge is getting people interested in science who are sure that they don't like science, or that science was never for them. Often that outlook is the consequence of bad or ineffective science teaching in school.

Another challenge is interacting with talk show hosts in ways that serve their specific audiences. So I force my delivery, vocabulary, conversational energy, and demeanor to adjust to the moment. Otherwise, with only one delivery style, you are square information trying to fit into a round media hole.

Q. How much outreach do you do globally (i.e. outside the US)?

My latest book, *Astrophysics for People In A Hurry*, is currently in 40 languages, including Dutch, Norwegian, Catalan, and Arabic. The



Neil deGrasse Tyson
Hayden Planetarium
American Museum of Natural History

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2014 *Cosmos: A SpaceTime Odyssey*, which I hosted, aired in 180 countries. So I'd like to think that counts as global outreach. My public talks, other than an occasional excursion to Australia, are almost entirely domestic.

Q. Have there been any measures made on the impact of the Hayden Planetarium, and if so what were the results?

The simplest measure is attendance. And the Museum has had multiple years of record attendance since the new Rose Center for Earth and Space, containing the rebuilt Hayden Planetarium, was opened in 2000. And though the space shows are key draws for visitors, Hayden's impact should also be measured by the activities of our personnel, especially those in the Museum's educational department, who plan and schedule hundreds of programs and activities each year, bringing science to the public in many and varied ways, and for all ages.

On the impacts of your *Cosmos* show, results? (I know I've suggested my cosmos students to watch it, and I myself have been viewing it.)

The *Cosmos* TV series, which I had the privilege of hosting in 2014, and will do so again for the 2019 release of season three (the first of which was the 1980 series by Carl Sagan) is technically a multipart documentary on the universe, but that's not what you feel when you watch it. The persistent juxtaposition of history, culture, meaning, and emotion instills within you an entirely different relationship to the universe — one where you are not an observer but a participant in the great unfolding of cosmic events. This potency relative to most documentaries cannot be overstated. And that is the legacy of the series, with Ann Druyan as the cowriter for all three incarnations of the franchise.

Q. What advice would you give to others trying to do outreach on a large or small scale?

Think about how other people think. Think about all the tangled mental roadways of confusion that may lurk in their minds, especially given today's incessant exposure to misinformation on the Internet. Find their receptors for learning, and feed them. Without that investment of pedagogical energy, you are simply lecturing to your audience, facing away from them as you write on the chalkboard, when you could otherwise be communicating with them.

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Spotlight on Outreach and Engaging the Public continued with FOEP's Vice-Chair Elect

Questions and Answers with FOEP's new elected Vice Chair-Elect
Shannon Swilley-Greco.

Q: You've been elected as Vice Chair Elect of FOEP! What's your day job?

I am a science education program leader at the Princeton Plasma Physics Laboratory. I develop, run and evaluate the success of education and outreach programs - things like research internships for high school and undergraduate students, expos for middle school students, public outreach events, etc. I present the work of PPPL in all kinds of settings to all kinds of audiences, usually with super cool demos. I try to excite people about our plasma and fusion without actually electrocuting them with the Tesla coil. Mostly, I'm successful.

Q: How did you get involved in outreach?

I started with a part-time job in an education-outreach office of a materials science research center at Princeton University to fund my travel around the world. I found I really loved engaging people with scientific research and improving the public understanding of STEM. I was *told* I was good at it, so I took it on as a career.

Q. What do you find most exciting about outreach? Most rewarding? Most difficult? Most important?

I think the best part is when people get so excited about it that they want to get involved - whether it's people offering personal checks to fund fusion or kids saying they want to be scientists. That's when your audience suddenly decides that scientific research is worth supporting with their time and/or money.

The most difficult part is convincing some researchers that it's worth it to return the favor - that it's in their best interest to



Shannon Swilley Greco
Science Education Program Leader
Princeton Plasma Physics Laboratory
Princeton University
Photo credit: Elle Starkman, PPPL

The most difficult part of outreach is convincing some researchers that it's worth it to return the favor - that it's in their best interest to cultivate an engaged public to ensure the growth of their field.

Connect with professionals! Most universities have at least one person, either funded by the university or by one of these research centers, who is experienced in getting even the most reluctant, introverted researcher to effectively communicate their work.

return the favor – that it's in their best interest to cultivate an engaged public to ensure the growth of their field.

Without an engaged public, the government doesn't have the voters' support to dedicate taxpayers' dollars to solving the millions of mysteries and challenges left to solve in the universe. Without outreach, we may be missing out on inspiring some of our brightest minds to take on these mysteries and challenges.



Photo credit: Elle Starkman, PPPL

Q. How did you happen to become the Science Education Program Leader of the Princeton Plasma Physics Laboratory?

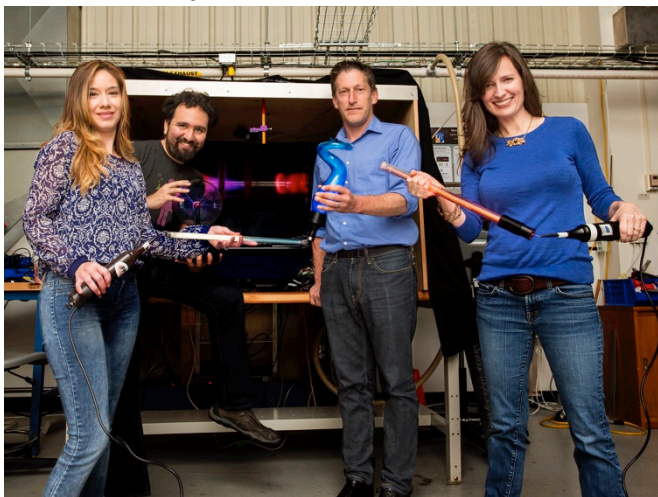


Photo credit: Elle Starkman, PPPL

After spending 12 years at the Princeton Center for Complex Materials helping scientists and engineers connect with the public, the opportunity came along to do that *and* do some of the teaching and engaging myself. The PPPL job was everything I liked about the PCCM job, but with more opportunities to be the presenter. I also completely fell in love with a lab that has one primary mission – nuclear fusion - that could save the world. That's pretty powerful.

Q. Has there been any studies done on the impact of the outreach you have done, and if so, what were they?

I've done my own studies (funding for outside evaluation is tough). SRI did an evaluation of all NSF Research Experience for Undergraduates programs and mine was one of those. They found around 70% of the participants went on to grad school. In my own PPPL longitudinal study, I'm finding that around 92% go on to grad school, but I also track them beyond



Photo credit: Elle Starkman, PPPL

grad school and 81% of those stay in STEM fields. (Actually, even among those who don't go to grad school, 60% stay in STEM.)

I've evaluated our expo events and consistently find that we improve participants' attitudes towards science and scientists and show a measurable positive impact on students seeing themselves as scientists.

Q. What advice would you give to others trying to do outreach on a large or small scale?

Connect with professionals! Most universities have at least one person, either funded by the university or by one of these research centers, who is experienced in getting even the most reluctant, introverted researcher to effectively communicate their work. AND those people have loads of opportunities to get involved. Whether they're looking for volunteers for their own program or helping you develop your ideas, education and outreach professionals want to help, and they can ensure you do more good than harm! (Yes, it's possible to turn people *off* from STEM, even if your heart's in the right place!)

Practice! Even from the morning to the afternoon in a one-day event, you'll see your science communication skills improve.



Photo credit: Elle Starkman, PPPL

Shannon recently met with the Energy Secretary Rick Perry during his visit to PPPL where he noted the importance of fusion research, that the coolest job he's ever had has been being Energy Secretary, and he gave a shout out to Shannon's impressive science outreach and education programs. You can read the article here: <https://www.pppl.gov/news/2018/08/energy-secretary-rick-perry-cheers-fusion-energy-science-education-pppl>

Dwight Nicholson Medal for Outreach

The Forum on Outreach and Engaging the Public assumes responsibility for this prize. This important APS prize consists of the Nicholson Medal and a certificate that includes the citation for which the recipient has been recognized. The Medal is sponsored by the friends of Dwight Nicholson, and through a generous gift from Professor Herb Berk, the Medal will be awarded with a stipend of \$2,000, beginning in Spring 2018. Up to \$1,500 will be available for the recipient's travel expenses to the meeting at which the Medal is presented.

The prize shall be awarded to a physicist who either through public lectures and public media, teaching, research, or science related activities has

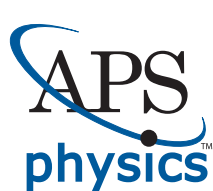
1. successfully stimulated the interest and involvement of the general public on the progress in physics, or
2. created special opportunities that inspire the scientific development of students or junior colleagues, or has developed programs for students at any level that facilitated positive career choices in physics, or
3. demonstrated a particularly giving and caring relationship as a mentor to students or colleagues, or has succeeded in motivating interest in physics through inspiring educational works.

Full details are at: <http://www.aps.org/programs/honors/awards/nicholson.cfm>

Nomination deadline is usually June 1.

Contributed by: E. Dan Dahlberg

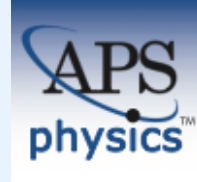
Know someone who would be deserving of the Nicholson award or worthy of being an APS Fellow? Don't wait!!! Start the nomination process now.



FOEP
**FORUM ON OUTREACH &
ENGAGING THE PUBLIC**



*Dwight
Nicholson
Medal for
Outreach*



FOEP Nominations for APS Fellows



What

APS Fellowship constitutes recognition by one's professional peers of exceptional contributions to the physics enterprise. Only a small fraction of the APS members reach the level of fellows and therefore this is an important recognition.

Who

Only APS members who are members of FOEP can be nominated for fellowship through FOEP. The deadline for Fellowship nominations is usually in May. We strive to have a diverse group of nominees and encourage the nomination of members of all underrepresented groups.

Who

How

Nomination is done entirely on-line. Complete instructions for the nomination are available at: <http://www.aps.org/programs/honors/fellowships/nominations.cfm>.

How

The process consists of: providing the nominee's contact and professional information, uploading nomination letters documenting the accomplishments of the nominee and explain why he or she is deserving of recognition. Note that it is the responsibility of the nominators to provide a compact however complete nomination.

Evaluation

Nominations are evaluated by the FOEP nomination committee, reviewed by the full APS Fellowship Committee, and finally submitted for approval to the APS Council.

Subject

Outreach is a broad enterprise, spanning academia, industry and national laboratories, as well as freelance professionals such as writers, journalists and bloggers. Outreach activities are often overlooked and undervalued. Thus it is important to think about and propose people who have an exceptional track record in this area.

Why

Nominating someone for APS fellowship takes time; however, it is a great way to emphasize the importance of reaching out to and engaging with the public. At the personal level it is very satisfactory to get recognition of your peers.

Contributed by: Ivan K Schuller

FOEP at the March and April Meetings 2018

MARCH MEETING 2018
LOS ANGELES MARCH 5-9

quarks 2018 cosmos

APRIL MEETING 2018

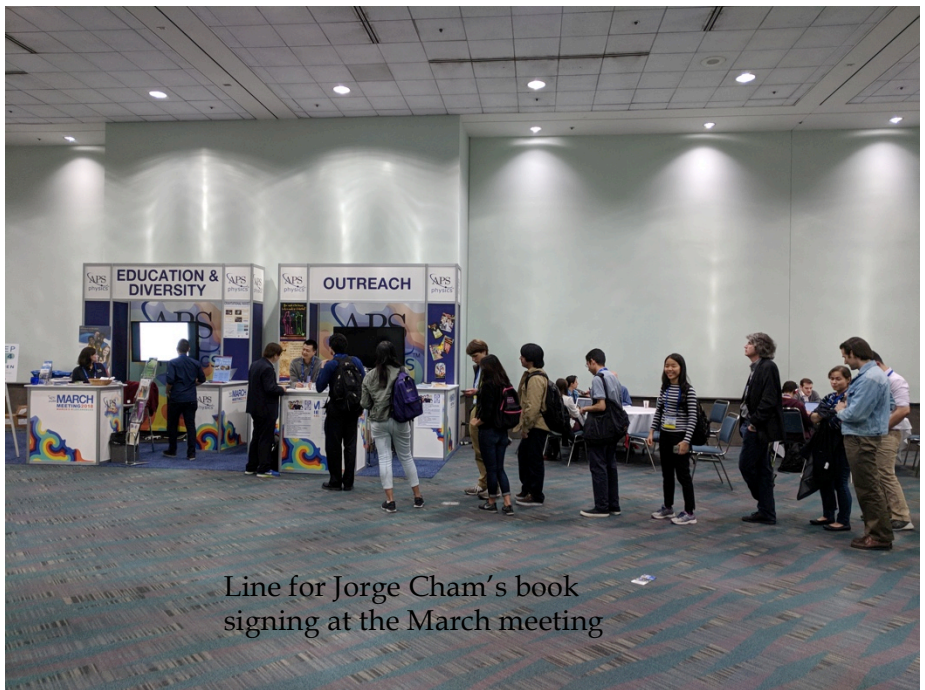
April 14-17, 2018 Columbus, Ohio

FOEP sponsored workshop at the APS March Meeting: Finding your scientific voice

FOEP again sponsored workshops at the APS March Meeting for postdocs and students to improve their communication skills. Participants learned best practices for communicating scientific results to an audience in the 10 minute talks typically given at the meeting during two 3-hour workshops. These workshops also help improve communication to the general public. FOEP intends to sponsor these workshops again at the APS March Meeting. FOEP is also looking into a possible workshop on written communication at the April meeting.

FOEP at the 2018 March Meeting.

Joe Niemala (ICTP) discussed the planning and execution of the International Year of Light celebration. Jorge Cham described the origin of his PhD Comics and web-based comic and video on the discovery of the Higgs Boson. Sam Sampere (Syracuse U.) and Tatiana Erukhimova (Texas A&M) described building outstanding outreach programs from a university physics department. Clara Moskowitz, Senior Editor for Scientific American, talked about how to publish articles in her iconic magazine. This year's talks displayed the breadth and diversity



Line for Jorge Cham's book signing at the March meeting

of efforts from using historical figures like Marie Curie to inspire STEM interest, to high-end video production inspired by the long-running University of Minnesota Physics Force shows, to examining the intersection between Lakota cosmology and particle physics! All of the APS Forum Contributed talks are considered non-technical talks so they can be given in addition to your technical science presentation at the same APS meeting. The Executive Committee strongly encourages you to volunteer to speak and to come to these sessions. Creative ideas can only disseminate if we share our stories.

Staged play reading at the March Meeting

FOEP once again joined with Brian Schwartz (CUNY) and other APS units (Forum on the History of Physics, Forum on Physics & Society, Committee on the Status of Women in Physics, and the Division of Astrophysics) to sponsor a staged reading of a play for APS members and the general public. This year Brian was joined by Smitha Vishveshwara (University of Illinois) to present a reading of the play *Silent Sky* by the [International City Theatre](#) of Long Beach CA. This play is based on the true story of 19th-

FOEP at the March and April Meetings 2018

century astronomer Henrietta Swan Leavitt and her personal journey at the Harvard Observatory in the early 1900's – a time of history-making scientific ferment but also a time when women's substantial contributions to science were suppressed or overlooked. The reading was informative and entertaining and made even more so by the talkback discussion with the play actors and a historian-scientist after the staged reading.

FOEP's invited session at the April meeting

The April Meeting invited session brought together speakers all doing very different types of outreach. The sessions started with Renee Horton of NASA who had just finished her term as president of the National Society of Black Physicists. She discussed her graphic novel series, *Dr. H Explores the Universe*, and her work with Unapologetically Being, Inc., a nonprofit devoted to advocacy and mentoring of those interested in a career in STEM. Her talk was inspiring, and she took time to answer audience questions about the best way to foster inclusion in STEM. Lucianne Walkowicz, the Baruch S. Blumberg NASA/Library of Congress Chair in Astrobiology in the John W. Kluge Center at the Library of Congress and noted TED speaker, discussed ways to bring science to people where they are instead of asking them to come to science. Her *Galaxy Ride*, a 300-mile science bike ride from Adler Planetarium to St. Louis, brought pop up science experiments to local communities along historic route 66. Rebecca Thompson discussed ways to use pop culture to teach physics in two different directions. She discussed how to make story forward comics that also teach physics and how to use existing pop culture phenomenon such as *Game of Thrones* as a jumping off point to physics. If you weren't at the talks you missed some fabulous *GoT* clips. The session concluded with Sam Sampere of Syracuse University talking about successful demo shows. He provided tips on how to put together a successful show, how to reach out to local TV stations to showcase your demos and he demonstrated how to build a few of his favorites. If you are headed to either March Meeting or April Meeting make sure to check out the FOEP sessions!

Free beer and snacks for FOEP members at the APS Happy Hour hosted by Becky Thompson

Every year at March Meeting FOEP in conjunction with the APS Outreach Department hosts a happy hour (free drinks!). The goal is to get people at all levels, from undergrads to tenured professors to public engagement professionals, together to talk about their work and build relationships. The event started as a way to build a community of outreach mini grant recipients but has grown far beyond that. This year the event was hosted at Prank Bar and featured great conversations and a few new collaborations. The event drew roughly 75 physics outreach enthusiasts this year and was mostly limited by space not interest. The "make your own throwie" station was almost as popular as the amazing buffalo cauliflower. If you are attending 2019's March Meeting be sure to look for information on the happy hour. If you are looking for collaborators or just a group to geek out on demos with, this is the place.

Double your exposure by giving an outreach talk in addition to your science talk!

The Forum for Outreach and Engaging the Public will have contributed talk sessions at the March and April meetings. *Importantly, these talks do not count against you, so you can still submit a scientific presentation.* We look forward to hearing about your work!

Report from you Councilor

by: Noah Finklestein

I'm grateful to serve on the APS Council of Representatives as your councilor (as well as councilor for the Forum on Education and the Topical Group on Physics Education Research). By way of reminder, the Council oversees the membership and units, scientific meetings, fellowships and prizes, policy statements and most standing committees and by-laws. Complementarily, the APS Board of Directors oversees the management of the society, corporate governance and finance, strategic directions, and final approval of policies and procedures. I always welcome your input and will be pleased to bring issues from this Forum to the council.

Brief updates from recent Council meetings and activity at APS central activities:

In the past year, APS has held two council meetings (Nov 2017, Apr 2018) and phone calls, virtual meetings and work online in between.

In short, the APS is healthy, financially viable, and seeking to undergo slow, adiabatic, incremental change to maintain our strengths, and adapt to changing landscape that physics finds itself in. As of April 2018, our membership rose to 55,368 (2.5% over the prior year). 2017 saw ~\$56M in revenue and \$55M in expenses. We continue to seek to grow our student and international membership and to connect to industry. We continue to engage in policy and making the case for physics. For example, in a study finished this last year, APS found 12.6% of the U.S. Gross Domestic Product is directly attributable to physics-based industries. Publishing remains a main avenue for showcasing the work of physicists and APS, and our journals remain a major source of revenue. We are adapting to new models of Open Access.

Current areas of focus of the Council and APS include:

- Policy. The Office of Public Affairs (OPA) has been renamed the Office of Government Affairs (OGA) to reflect more accurately the Society's advocacy and lobbying activities. The purpose of the OGA is to, "facilitate communication between physicists and government entities, including the Administration, Congress, and funding agencies, on scientific issues of concern to APS members, to the scientific community, and to the nation as a whole. In collaboration with two APS member committees - the Panel on Public Affairs (POPA) and the Physics Policy Committee (PPC) - the OGA is responsible for developing internal and external policy positions for APS and advocating on behalf of APS for the advancement and support of physics and science more broadly." Francis "Slake" Slakey has been named Chief Government Affairs Officer (CGAO). More on the impressive work of this office can be found [here](#).
- Strategic Planning for APS. As you may be aware, last year APS undertook a strategic planning process and anticipates having a strategic plan for review this fall (November Council meeting). The four pillars approach is an effort to implement a vision of "One APS." This strategic plan focuses on:
 - o Scientific Research Dissemination: promoting our role in the scientific enterprise.
 - o Serving Communities: programmatic work, outreach, diversity, education,

governmental affairs.

- **Securing Financial Sustainability:** ensuring a stable organization in light of changing membership demographics and a rapidly evolving publishing landscape.
- **Increasing Organizational Excellence:** ensuring the structure and operations of APS are serving our mission and goals.

Largely this effort is being undertaken by the Senior Management Team, APS Staff and Volunteer Leaders, with involvement of subcommittees focusing on the above and facilitated by an external consultant. While FOEP will be instrumental in all of these areas of focus, I will pay particular attention to the role FOEP might contribute to on the pillar of Serving Communities.

- Review of our Prizes and Awards to ensure these are fully funded, are aligned with mission /vision of the units, and represent and promote diversity of membership. For FOEP, the Prizes and Awards Committee is coordinating with this unit on the Dwight Nicholson Medal.

Additional APS items of potential interest:

Interested in getting more involved with the Office of Government Affairs? I'd recommend checking out the [Advocacy Dashboard](#) and sign up for [Signal Boost](#) a monthly update on APS policy.

Some exciting advances from Education and Diversity at APS:

Effective Practices for Physics Programs Guide (EP3, formerly [BPUPP](#)). The American Physical Society, in collaboration with the American Association of Physics Teachers, is leading an effort to create a guide of effective practices related to all aspects of undergraduate physics programs. EP3 will have a section helping guide departments to think about evidence-based approaches that encourage students to pursue science. The project is in the process of identifying individuals who can serve as contributors and reviewers. Please contact [Noah Finklestein \(finkels@colorado.edu\)](mailto:finkels@colorado.edu) or [Ted Hodapp \(hodapp@aps.org\)](mailto:hodapp@aps.org) if you think you are one of those people, or know someone who is.

[Step Up 4 Women in physics.](#) This project is trying a radical approach to increasing women in physics by enlisting high school teachers to directly recruit women in their classes to consider majoring in physics in college. If you know high school teachers, or teacher leaders who you think could help APS with this, please send information to Kathyne Woodle (woodle@aps.org), the STEP UP Project manager.

The Inclusive Graduate Education Network (IGEN) builds on the extremely successful [APS Bridge Program](#) by expanding these principles and strategies to all of the physical sciences. Many Bridge students are involved in outreach and recruiting efforts. If you are interested in engaging them, we suggest you contact the APS Bridge Program Manager, Erika Brown (brown@aps.org), or attend the national conference to be held at Google Headquarters and Stanford on 16-18 November.

PhysTEC, an APS signature program to increase the number and quality preparation of precollege physics teachers, has recently released a study of thriving programs. Check it out or use the tool, [Physics Teacher Education Program Analysis \(PTEPA\) Rubric](#), which was developed to characterize the practices and structures observed at thriving programs. PTEPA provides a guide for program leaders to reflect upon and improve their programs, and enables measurement and research over time.

There will be two Council meetings where I will be pleased to share FOEP issues, concerns, and celebrations. The October meeting will be shorter and online focused on our Strategic Plan, while the November, longer and in person. I welcome your feedback and areas you wish to bring up to Council (through the FOEP executive board).

Noah Finkelstein is a Professor of Physics at the University of Colorado Boulder and conducts research in physics education, specifically studying the conditions that support students' interests and abilities in physics – developing models of context. In parallel, he conducts research on how educational transformations get taken up, spread, and sustained. He is a PI in the Physics Education Research (PER) group and a co-director of CU's Center for STEM Learning. He co-directs the national Network of STEM Education Centers, is helping build the STEM DBER-Alliance, and coalitions advancing undergraduate education transformation. He is involved in education policy serving on many national boards, is a Trustee of the Higher Learning Commission, is a Fellow of the American Physical Society, and a Presidential Teaching Scholar and the inaugural Timmerhaus Teaching Ambassador for the University of Colorado system.

Physics at the Movies

by: James Kakalios

While I don't go to my local movie theater with a pad of paper and a calculator, waiting for my "physics-sense" to start tingling, I have found that superhero and science fiction films can provide wonderful opportunities to engage with the public. Interest in a recent blockbuster can be leveraged, and the impossible on the big screen can be used as a "teachable moment" about real world physics.

For example, the Black Panther made his solo big screen debut in the Marvel Cinematic Universe this past February, and the broader, non-comic book reading public learned about the technologically advanced country of Wakanda. The wealth of certain nations is correlated with the natural resources found within its borders. Think of the oil-rich countries in the Middle East, or the abundant timber forests of Canada. In the Marvel universe, one of the most fortunate countries on the face of the planet is Wakanda, for in these lands an extra-terrestrial meteorite landed, depositing a rich load of an extremely rare and valuable mineral – vibranium.

As suggested by its name, vibranium's unique properties relate to how the atoms in this material process external sources of vibrations. In particular, vibranium is a perfect shock absorber, converting the kinetic energy and atomic vibrations from any projectile into non-lethal forms of energy. The king of Wakanda, T'Challa, defends his country as the superhero the Black Panther, wearing a suit composed of vibranium that provides head-to-toe bullet-proof shielding. The kinetic energy of a bullet will ordinarily cause such extreme atomic vibrations that the chemical bonds holding together the outer uniform will be broken, and the bullet will penetrate through to your body, causing comparable damage. When a bullet strikes a vibranium suit its kinetic energy is presumably rapidly shunted away from the point of impact, and transformed into a less destructive form. While vibranium does not exist in our more mundane, non-superhero world, there are real-world materials that can approximate these amazing properties.

A simpler term for vibrating atoms is 'sound,' and all matter, whether vapor, liquid or solid, is able to transmit sound waves. How easily sound can propagate through an object depends on factors such as its density and the strength of the connections between neighboring atoms. Sound moves much faster (in general) through a solid than through air – which is why you'll hear the approach of the distant train much sooner if you feel (or hear) the locomotive's vibrations through the steel rails, rather than waiting for the sound to reach you through the air.

Sound can be damped if the energy of the atomic vibrations can be deflected into other directions or other channels. The sound in the steel rail does not continue forever – some of the atomic vibrations transfer their energy to the surrounding air, which then carries some of the sound's energy away from the metal. When enough energy is transferred, the amplitude of the sound's vibrations becomes comparable to the atomic vibrations that all matter at a given temperature has, and the sound will have dissipated.

So, one way to make a 'bullet-proof' analog of vibranium is to make a material that transmits the localized kinetic energy of an incoming projectile away from the point of impact before the atomic vibrations are able to break the chemical bonds holding the material together. A good rule of thumb will be – the faster the speed of sound in a material, the harder it will be to penetrate the material with an external projectile. Recent studies of graphene, a unique ultra-thin form of carbon that is only one atom thick, where the carbon atoms are arranged in a honeycomb, hexagonal pattern, find that its speed of sound is extremely high.

Consequently, as experimentally verified by Jae-Hwang Lee, Phillip E. Loya, Jun Lou and Edwin L. Thomas (*Science* **346**, 1092 (2014)) much more energy is needed to penetrate multiple layers of graphene, compared to a comparable mass of steel, or even Kevlar.

Sweeping the atomic vibrations away from the point of impact will protect the region where the external kinetic energy first strikes the graphene, but the energy is still present in the material. One way to handle these vibrations is to convert them into another form of energy that is less harmful to the material (and any person wearing such a super-suit). There is a phenomenon termed ‘sonoluminescence’ where sound waves are converted into light. The energy of a sound wave is typically many times smaller than the energy in a beam of light, so this is one way that a large amount of kinetic energy due to an impacting projectile could be transformed into a non-lethal form.

In the Black Panther film, we learn that the Panther’s sister Shuri, a scientific genius who’s skills rival Tony Stark’s, has refined the Black Panther suit so that it can store incident kinetic energy, and release it in a single focused blast. Perhaps the suit has a series of fiber optic cables woven into its fabric, so that the light generated by the sonoluminescent process can be carried off and stored in some sort of ‘optical battery,’ to be dramatically discharged at some later time. I certainly could not design and fabricate such a suit and mechanism but someone Shuri can!

The popularity of the Black Panther movie led to additional outreach opportunities. A question on the on-line forum Quora.com regarding T’Challa’s vibranium suit and the DC comics superhero the Flash led to a discussion of the physics of vibranium and quantum mechanics.

Devoted fans of any field love to debate, and among the things they love to debate are hypothetical questions. Would the 1927 New York Yankees beat the 1998 Yankees? Which year was better for film: 1939 or 1973 or 1982? Who would win a heavyweight title bout: Muhammad Ali or Rocky (Marciano, not Balboa)? And a perennial favorite of comic book fans: Who is faster, Superman or the Flash?

This last one is easy: the Flash. After all, they have run at least seven races, and they tied twice, with the Scarlet Speedster winning five. (And, as the Flash has noted, those two races that ended in a draw were for charity events). A less obvious hypothetical question was raised on Quora.com: could the Flash vibrate his hand through the Black Panther’s vibranium suit? Of course, both the Flash and the Black Panther are heroes in their respective comic book universes, and there would be no reason for the Flash to try to harm the Black Panther. But given that vibranium has the ability to absorb all external vibrations – could even the Crimson Comet vibrate through such a suit?

Some background, or Flash Facts, if you will. In *Showcase* no. 4 in 1956, police scientist Barry Allen was struck by lightning while simultaneously being doused with the contents of a bookshelf full of various chemicals. Rather than suffering permanent neurological damage he gained the ability to run at super-speed. Donning a sleek red and yellow costume and calling himself the Flash, Allen fought for justice using his many new super-powers. In addition to secondary powers necessary for an effective use of super-speed (such as super-acceleration, super resistance to air-drag, super-metabolism), the Flash also had the ability to independently control his body’s vibrations, with which he could ‘phase’ through solid walls.

Now while the Sultan of Speed can indeed run through solid objects (I’ve seen him do it on TV and in the comics, and they couldn’t show it if it weren’t true!), he does so not by matching his vibrations to those of the object. Anything that is not at a temperature of absolute zero has some internal kinetic energy, and for the atoms held in fixed positions, as in a solid wall, this energy manifests as the atoms vibrating back and

forth about their average position. After all, your own atoms vibrate with a frequency that corresponds to your body temperature of 98.6° Fahrenheit, but don't try walking through a wall that's also at 98.6°F.

Rather, I would argue that the Scarlet Speedster makes use of quantum mechanical tunneling. One aspect of the wave-like nature of matter described by quantum mechanics is that there is a probability for the wave to be transmitted through a solid barrier, with the object showing up on the other side. The greater the kinetic energy of an object, the larger is the probability that it can wind up on the other side of a barrier. Thus if the Flash were to run, or just move his hand, fast enough, he *could* increase the probability of tunneling to near 100%, and would appear to 'phase' through the solid barrier. While there is much wrong with this proposed mechanism for 'phasing,' it did provide an excuse for me to describe quantum physics and tunneling on the Quora.com board!

So, while the Black Panther's suit would indeed absorb the excess vibrations of the Flash's hand moving rapidly back and forth, the Viceroy of Velocity (and yes, these are all nicknames the Flash has had in the comics) could move his hand forward so fast that it behaved like a macroscopic quantum object. When an object tunnels through a barrier, it is not technically inside the barrier (just on one side of the barrier and then on the other side), and thus there is no energy for the vibranium suit to absorb. Fortunately in either comic book universe it would be hard to find two more honorable and decent heroes than the Flash and Black Panther, and this question will remain, thankfully, hypothetical.

James Kakalios is the Vice-Chair of the Forum on Outreach and Engaging the Public, and the Taylor Distinguished Professor in the School of Physics and Astronomy at the University of Minnesota. He is the author of several popular science books, including *THE PHYSICS OF SUPERHEROES* (Avery, 2009) and *THE PHYSICS OF EVERYDAY THINGS* (Crown, 2017).



James Kakalios
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Outreach: From the Graduate Student Perspective

by: Rachel Henderson

Jessie Micallef is a third-year graduate student at Michigan State University (MSU) getting a dual PhD in Physics and Computational Mathematics, Science, and Engineering. She works on the particle physics experiment IceCube under Professor Tyce DeYoung studying neutrino oscillations. She is both a NSF Graduate Fellow and Intel/SIGHPC computational fellowship recipient.



What experiences do you or your University have involving physics outreach?

I've been part of the Women and Minorities in the Physical Sciences (WaMPS) group since I first got to MSU. It was one of the reasons I wanted to come to MSU, so I made a point to get involved right away. I was elected as First Year Liaison, Vice President, then President in my first three years. WaMPS gets involved in regular outreach, like showing demos at Girls Math and Science Day and other local science festival events. In addition, WaMPS also gets involved deeper with the department community. We run mentoring programs where we assign individual graduate mentors to the REU students in summer and first year grad students in the Fall. I have been a mentor for both of those programs and have made some valuable connections with my mentees. We also make a point to strengthen the physics community within our department. For example, the department asked us to hold a meeting to brainstorm ideas to improve recruiting women and minorities to attend MSU for grad school. Because of WaMPS, I also got involved in planning the 2019 Conference for Undergraduate Women in Physics that is going to be held at MSU. I've also participated in multiple workshops that uses movement and dance to teach physics.

How did you get involved in outreach?

In undergrad, I was part of the Society of Women in Physics (SWIP) at University of Michigan. It was a group for undergrads, grads, and faculty who did some really great events, including organizing the Conference for Undergraduate Women in Physics in 2015 and doing yearly outreach with the girl scouts and local middle schools. Once I got to MSU as a grad student, I looked for a similar organization and ended up working with WaMPS. WaMPS does a lot and I really aligned with their core values, so most of the outreach I have done as a graduate student has been through them in some capacity.

What is your favorite part of participating in outreach events?

I really like seeing the effect that outreach has on the students. Whether it is getting young students excited about physics or seeing the graduate student community grow, the results of outreach is the most rewarding part for me. I really like when young students come in, expecting physics to be boring, and we get them super excited about what we're doing. One of my favorite moments was when we built cloud chambers with high school students. When the grad volunteers were practicing building them, we were thrilled to see the particle tracks in the chamber--but this is the science we chose to get a PhD in. It was funny to see the high school students just as excited as us physicists when we showed it to them though. But more than just that excitement, it's knowing that you changed their perspective. You made physics cool and fun. It's similar with mentoring undergrads and even other grads. The best part is seeing them gain confidence and start to recognize that they're going to be able to accomplish their goals. They go from asking questions to having a plan figured out for their future.

As a graduate student, how can the APS Forum on Outreach and Engaging the Public (FOEP) help you become successful with your efforts in physics/astronomy outreach?

WaMPS has a lot of programs, but one thing we recently wanted to start was a seminar series for careers that physicists have gone into, and we were having trouble compiling a list of speakers. I think it would be great if FOEP could compile a list of speakers and outreach groups along with their contact information. It would be helpful for scientists that are beginning an outreach program to have a reference to use to find others that are also involved in similar activities. For example, at MSU we could use this list to bring a speaker in and open it up to the community. I think bridging the gap between the physicists and the public is very important. So I think if FOEP supported us with the resources to easily identify and contact speakers, it would be possible for many groups to take advantage of the list and hold a public lecture series to get their community more excited about physics.

Stay tuned for more perspectives on outreach from other Physics & Astronomy Graduate Students!



Keep an eye on the lookout for our great FOEP sponsored workshops on finding your scientific voice and possible future writing for the media workshops

Double your exposure by giving an outreach talk in addition to your science talk!

The Forum for Outreach and Engaging the Public will have contributed talk sessions at the March and April meetings. *Importantly, these talks do not count against you, so you can still submit a scientific presentation.* We look forward to hearing about your work!

Outreach Info & Resources

info

APS Physics Central has an “Outreach Guide!”

The guide provides ideas, opportunities, and information on how to conduct various types of outreach.

Check it out! <https://www.aps.org/programs/outreach/guide/>

And within this guide you'll find information about:

Outreach Ideas

- [Physics on the Road](#)
- [Public Lectures - One Time](#)
- [Public Lectures - Series](#)
- [Open Houses](#)
- [Science Cafes](#)
- [Demo Shows \(on campus\)](#)
- [Working with a Museum](#)

Outreach Tips

- [Public Relations](#)
- [Working with Children and Schools](#)

[Demos List](#), [Experts](#)

The Institute of Physics has a website devoted to Public Engagement

This website provides ideas for outreach activities, how to run an event, evaluation of an event or activity, as well as sign ups for events (in the UK).

<http://www.iop.org/activity/outreach/>

Find out about their 3 minute wonder challenge:

http://www.iop.org/activity/3-minute-wonder/page_60438.html

The Alan Alda Center for Communicating Science

Has many resources, and classes you can sign up for at Stony Brook University. There is a “Workshops on the Road” program that visits other locations. Check out their website for ideas and information.

<http://www.centerforcommunicatingscience.org/alan-alda/>

Questions and Ideas



Want to get more involved?

Email someone on the executive committee. Contact info can be found on the last page of this newsletter or online at:

The Forum on Outreach and Engaging the Public at

<http://www.aps.org/units/foep/governance/officers/index.cfm>

Newsworthy Items?

Have an idea for something to include in the Newsletter: An outreach activity, an idea for an article, best practices, what does and doesn't work, or something else? Please send your ideas to the newsletter editor at

FOEPAPSnewsletter@gmail.com

Web Sites that Engage and Inform the Public

info

3Blue1Brown: <https://www.youtube.com/watch?v=spUNpyF58BY>

Minute Physics: <https://www.youtube.com/user/minutephysics>

Veritasium: <https://www.youtube.com/user/1veritasium>

Mathologer: <https://www.youtube.com/watch?v=YuIjLr6vUA>

Kurzgesagt – In a Nutshell

<https://www.youtube.com/channel/UCsXVv37bltHxD1rDPwtNM8Q>

Smarter Every Day: <https://www.youtube.com/user/destinws2>

Vihart: <https://www.youtube.com/user/Vihart>

Physics Tutorials: <https://www.physicsclassroom.com/Physics-Tutorial>

Fermilab videos: <https://tinyurl.com/drdonvideo>

APS Physics Central:

Physics in Action, Physics in Pictures, Physics +, Physics@Home, and more

<http://www.physicscentral.com>

OSA's Optics for Kids website:

Activities, Celebrities, Timelines, and more

<http://www.optics4kids.org/home/>

IOP Physics.org: <http://www.physics.org>

NASA Outreach Resources

<http://science.nasa.gov/researchers/education-public-outreach/>

Expanding your Horizons Network

<http://www.eyhn.org/aboutmain>

International Particle Physics Outreach Group

<http://ippog.org/resources/types/activities>



Let FOEP Post Your Outreach Links

Do you have a favorite web site, web article, and or video you like, or perhaps your own outreach website? Send it to us for consideration of inclusion on this page so everyone can enjoy it. Send ideas to: FOEPAPSnewsletter@gmail.com

Funding Information

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APS grants for public outreach and informing the public

APS annually awards several grants up to \$10,000 to help APS members develop new physics outreach activities. Programs can be for traditional K-12 audiences or projects for engaging the public.

<http://www.aps.org/programs/outreach/grants/>

Marsh W. White Awards are made to Society of Physics Students Chapters "to support projects designed to promote interest in physics among students and the general public."

<https://www.spsnational.org/awards/marsh-white>

SPIE education and outreach grants for photonics and optics

As part of its education outreach mission, SPIE provides support for optics and photonics related education outreach projects.

<http://spie.org/education/education-outreach-resources/education-outreach-grants>

AAPT - American Association of Physics Teachers

Bauder Fund Grants for Physics Outreach Programs

Can provide funds to obtain and or build and support traveling exhibits of apparatus.

<http://www.aapt.org/Programs/grants/bauderfund.cfm>

Alfred P. Sloan Foundation

The Alfred P. Sloan Foundation offers grants toward promoting science and science understanding to the general public.

<https://sloan.org/grants/apply>

IOP Institute of Physics

Public Engagement Grants – open to all but only for projects that take place within the UK and Ireland

https://www.iop.org/about/grants/outreach/page_38843.html

EPS European Physical Society

Two grants that can fall into the outreach category are the EPS grant for Regional Physical Society Meetings that include items outside their usual grant categories, and EPS Award for Pre-University International Physics Competitions.

http://www.eps.org/?page=support_grants

Many institutions have their own internal outreach funding programs.

Contributed by: H.M. Doss



FOEP

**FORUM ON OUTREACH &
ENGAGING THE PUBLIC**

PHYSICS OUTREACH & ENGAGEMENT

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FOEP Membership – Join Today

To join FOEP at no cost prior to renewing your APS membership, you can get your ID badge scanned at a meeting, send an email to membership@aps.org with your request to add FOEP to your membership, or send a letter requesting membership to APS membership department. Please note that if you currently belong to two or more forums, FOEP will be added at no charge for the remainder of your membership term. On your next membership renewal notice, you will see a Forum subtotal that will include \$10 for every Forum membership over two.

Physics Outreach & Engagement is a non-peer-reviewed newsletter of the Forum on Outreach and Engaging the Public, a forum of the American Physical Society. It provides information and news related to the Forum and provides a medium for Forum members to exchange ideas. Opinions expressed are those of the authors alone and do not necessarily reflect the views of the APS or of the Forum. If you would like to submit an article, commentary, letter, review, or contact us about another issue, please email the editor, FOEPAPSnewsletter@gmail.com

The Forum on Outreach and Engaging the Public can be found on the web at <http://www.aps.org/units/foep/index.cfm>