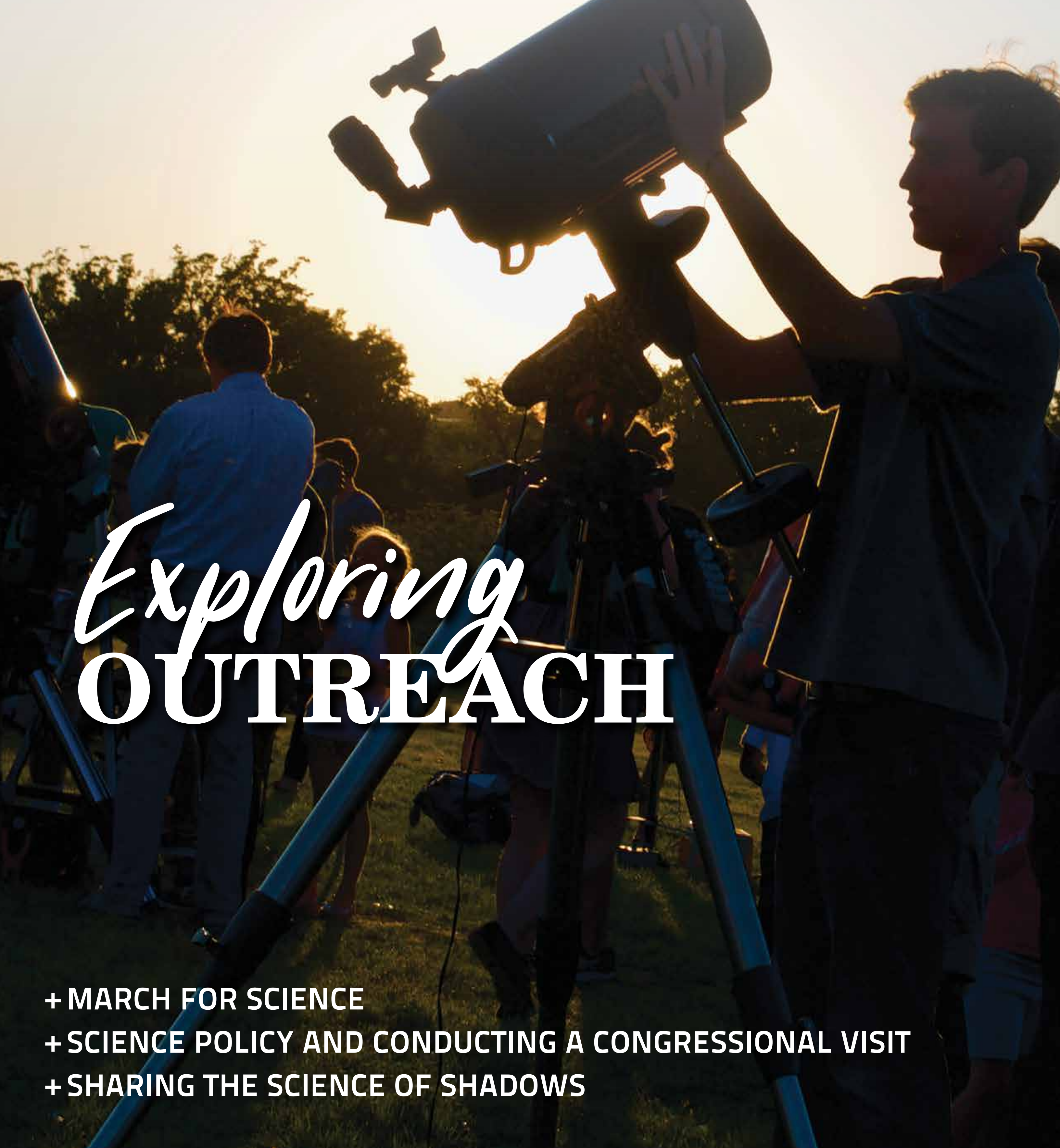
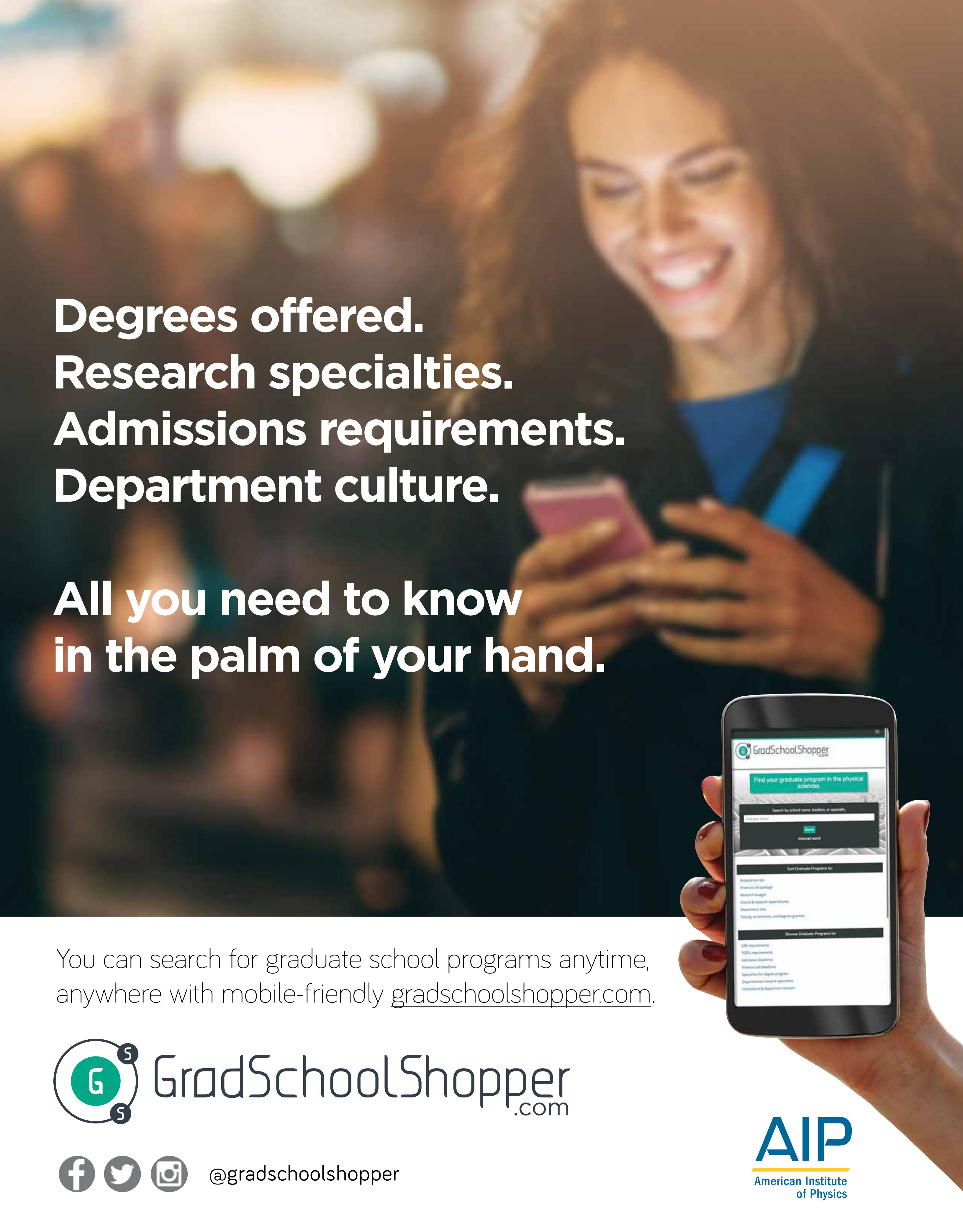
the SPS Observer

Volume LI, Issue 2
SUMMER 2017



Exploring OUTREACH

+ MARCH FOR SCIENCE
+ SCIENCE POLICY AND CONDUCTING A CONGRESSIONAL VISIT
+ SHARING THE SCIENCE OF SHADOWS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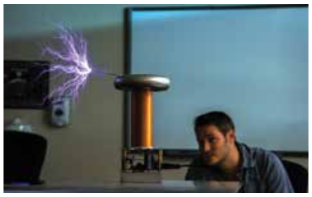

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Welcoming the New President
of the Society of Physics Students!

by Alina Gearba-Sell, PhD, Incoming President of the Society of Physics Students and Associate Professor, Department of Physics, United States Air Force Academy

Greetings and thank you for trusting me to become the next president of the Society of Physics Students!

After serving on the SPS National Council as the faculty representative of Mississippi, Louisiana, Arkansas, and Western Tennessee (Zone 10), I am thrilled to continue serving the society and its diverse student membership. I look forward to working with the associate and zone councilors to reach out to every SPS chapter in the country in support of your activities. I am also eager to work with the SPS National Office and the American Institute of Physics to enhance our current programs, as well as create new programs and initiatives for the benefit of the undergraduate physics community.

I first became acquainted with SPS in 2004 as a new faculty member at the University of Southern Mississippi. Having completed my undergraduate studies in Romania, I was not familiar with SPS, yet there I was, tasked with the SPS faculty advisor position.

The chapter had been dormant for years and I did not know what to do at first, but, fortunately, I was not alone. I had the help of several enthusiastic students—Amanda Palchak, Ty McCleery, Kileigh Peturis, Greg Carson, Xandria McWaters, Kyle Fortenberry, Charles Young, Alyece Willoughby, Kinsey Zarske, and many others—who were just as passionate about making physics an inclusive community as I was. Together, we turned the Southern Miss chapter into one of the most recognized SPS chapters in the nation. The SPS National Office proved to be an unmatched resource in making our chapter successful. It was then, during those years at Southern Miss, that I came to realize how much I missed out on during my undergraduate career in Romania by not having the support of a national student organization. It was then that I made a lifelong commitment to the SPS mission of "helping students transform themselves into contributing members of the professional community."

My academic career took me to the United States Air Force Academy where, once again, I became the SPS faculty advisor. The chapter was extremely active locally, participating in a variety of outreach events in the community, but was not active regionally or nationally. Once again, I relied on students—Jared Wesemann, Anne Werkley, Jeremiah Wells, Daniel Weisz, Scott Alsid, Will Dickinson, and Anita Dunsmore—to take that next step in our chapter's journey. We started attending zone meetings—we even hosted one! We went to PhysCon in San Francisco last fall, we received research and outreach awards, and we were recognized for a second consecutive year in 2016 as an Outstanding SPS Chapter.

Why am I sharing my story with you? Because I truly believe that SPS can enrich your experience outside the classroom. Networking, leadership skills, opportunities to present scholarly work at professional meetings, research and outreach awards, scholarships, and internships will benefit you for a lifetime. So, if you are a leader in your SPS chapter, please embrace it with all your heart. I know

INCOMING SPS PRESIDENT Alina Gearba-Sell, PhD, United States Air Force Academy. Photo courtesy of Alina Gearba-Sell.

it is not always easy to balance school, work, and service commitments as well as a personal life, but the rewards are tremendous. If you don't know where to start, look around you for more enthusiastic students. They are everywhere! You will be amazed at how resourceful you can be. Strong chapter leadership is essential for the success of your chapter. The SPS National Office and I will be by your side every step of the way. We realize that SPS chapters are diverse and face unique challenges, but we are committed to address your individual needs and make your chapter really shine.

A new academic year is starting. Check out the SPS National programs, resources, and opportunities, and don't hesitate to call us if we can make your physics life even more amazing. //

https://www.spsnational.org/programs

Building Community & Crossing Boundaries

Dr. Blane Baker Named SPS Outstanding Chapter Advisor for 2015–16

by Kendra Redmond, Contributing Writer

The 2016 SPS Outstanding Chapter Advisor Award is the most prestigious award given by SPS, bestowed annually on the basis of the leadership, student leadership development, support, and encouragement the advisor has provided to his or her chapter.

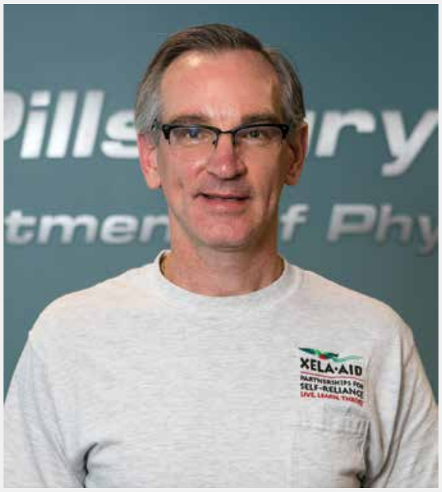
At the foot of a 10,000-foot volcano, Dr. Blane Baker's students looked at him. "If you'll do it, we'll do it." Together, the small group from William Jewell College started climbing, pushing, and motivating each other all the way to the summit.

Whether climbing a volcano in Guatemala, distributing hundreds of donuts at a campus event, or guiding students through condensed-matter experiments, Baker is always building community. "Physics is fun, accessible, exciting, and empowering," he says. "We as a physics community need to reach out to folks everywhere in the world, across all kinds of boundaries."

When he became the William Jewell College SPS advisor 13 years ago, Baker's primary goal was to build community within the physics department. As their bonds deepened, the members decided they wanted to use physics to serve others locally, regionally, nationally, and even internationally.

Under Baker's leadership, the chapter now promotes science on campus with "Demos and Donuts on the Quad" and other events. They partner with local inner-city schools, leading physics outreach events and talking about what it means to be a scientist. The chapter has hosted science camps on the Cheyenne River Reservation in South Dakota, on the Texas–Mexico border, and in poor regions of Kansas City and Arkansas. In the summer of 2015, physics students and faculty members (including Baker) traveled to San Martín, Guatemala, and taught students how to build solar energy lanterns so they can study after dark. Similar projects have taken Baker and his students to Haiti and Thailand.

In addition to supporting and often accompanying students on these adventures, Baker is known on campus for his engaging teaching style, the popular sports science class he designed and teaches, and



his caring attitude. Students are individuals, he says, and so he treats them as individuals—asking about their interests and goals, checking in, offering extra help, sharing professional connections, and staying accessible. He is active in condensed matter and physics education research, often coauthoring scientific papers with students.

"Dr. Baker's ability to creatively challenge students in research and in course

TOP LEFT: Baker (right) engages with students on campus during "Demos and Donuts on the Quad." Photo by Amy Kontras.

BOTTOM LEFT: Blane Baker. Photo by Amy Stroth, William Jewell College.

ABOVE: On a recent trip to the Fang district in Thailand, Baker (back row, right) and two students from William Jewell College helped villagers construct an aquaponics system out of an existing catfish pond. Local plants placed in the floating raft draw nutrients from the water in the pond and help to filter the pond. Photo by Jeff Buscher.

Advice to SPS Advisors:

If you feel like you're inundated and it's difficult to carry on, just think about doing one or two things with your SPS chapter. Then, expand on those over time. The hardest part is to start.

Advice to Students:

Pursue your passions. Studying physics is a great way to develop interdisciplinary skills and interests. With a physics degree, you can do so many things in the world today.

projects forms us into real world problem solvers," wrote one of Baker's students in a nomination letter. "I have learned a lot from Dr. Baker, not only in terms of what it means to be a good physicist, but also what it means to be a good person," wrote another. "I have never seen anyone better at working with a student who is struggling," wrote one of Baker's colleagues. "His patience and guidance bring out the best in the students."

Whether barriers to progress are physical, academic, cultural, socioeconomic, or otherwise, Baker believes that an inclusive physics community can be a powerful force for good. "We really need to build community in the world," he says. "Science is accessible to everyone. It impacts all of us." //

It Pays to Buy in Bulk

Savvy budgeters know that to get the best deal on cereal, canned tomatoes, and toilet paper, you should buy in bulk—it's why warehouse stores like Costco exist, after all. Turns out the same is true for SPS memberships. If your chapter registers multiple students at the same time, you can get a significant discount (up to 25%).

One group to take advantage of this deal recently was the Sam Houston State University chapter, whose newly minted advisor, Dr. John Wilson, spoke to SPS National about the benefits of the bulk membership discount.

[SPS] What is the makeup of your chapter?

Sam Houston State University has roughly 50 physics majors yearly. I encouraged students to register, and currently, 30 students have joined Sam Houston's SPS chapter. It's a mix of underclassmen, but mostly upperclassmen.

The chapter had really been down in the dumps for about 2 years. With so many physics majors, I stepped in to reinvigorate the chapter and get as many students registered to SPS as possible.

[SPS] What made you decide to participate in the bulk membership discount?

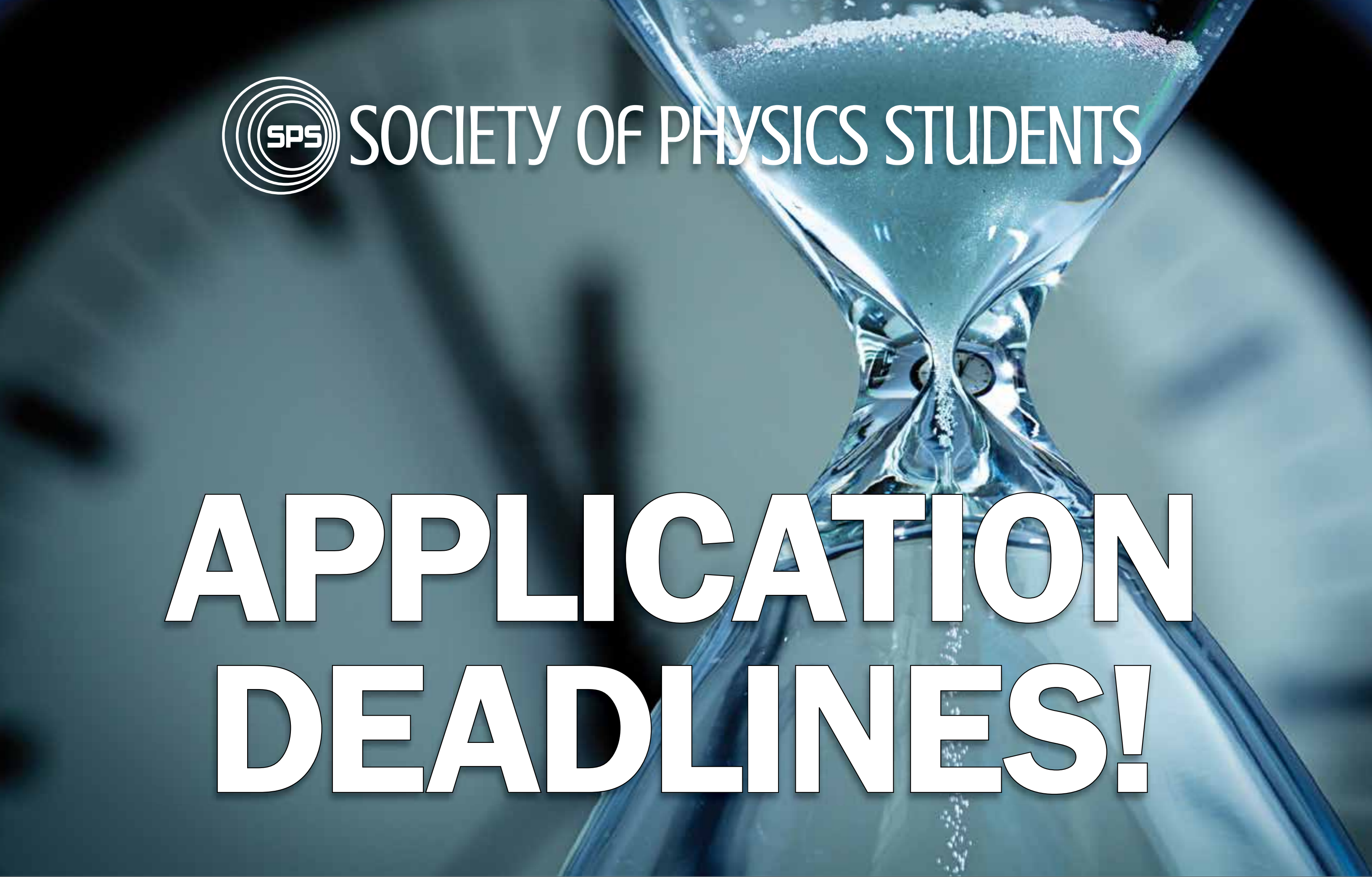
We needed to reestablish the chapter. This was an easy way to encourage physics majors to take advantage of benefits such as access to scholarships and awards and information from SPS National. We ended up registering 30 students.

[SPS] Did you do anything else to encourage students to take part in the discount?

Sam Houston State agreed to cover the membership costs for all 30 students at the discounted rate. This was a huge help and signified the importance of our SPS chapter to the university. //

To take advantage of bulk memberships for your chapter, visit

https://www.spsnational.org/about/membership



SOCIETY OF PHYSICS STUDENTS

APPLICATION DEADLINES!

Mark your calendars!

The Society of Physics Students (SPS) and Sigma Pi Sigma have consolidated deadlines for awards, scholarships, and internships. There is now one deadline each season. These opportunities are available only to chapters and members, so remember to pay your dues to qualify.

FALL DEADLINE: November 15
Sigma Pi Sigma Chapter Project Award
Future Faces of Physics Award
SPS Chapter Research Award
Marsh W. White Award

WINTER DEADLINE: January 15
SPS Internships

SPRING DEADLINE: March 15
Outstanding Chapter Advisor Award
SPS Award for Outstanding Undergraduate Research
SPS Scholarships

SUMMER DEADLINE: June 15
Chapter Reports—Including the Blake Lilly Prize

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Leveraging the Untapped Power of Informational Interviews

by Susan Martin, Program Director, PhD Career & Professional Development, University of Maryland

"What kind of work do you want to do?" is a seemingly simple question that most undergraduates cannot convincingly answer for themselves, faculty mentors, academic advisers, or even potential employers. Students often hear that there are multiple career paths available to them, but many students do not have a clear understanding of the common areas of employment or job titles for those with physics or astronomy bachelor's degrees. Based on years of experience advising and doing career development work with diverse STEM majors, I have found that informational interviewing is one of the most effective ways for students to gain in-depth knowledge about possible jobs and employment options in different industries. Students who conduct informational interviews expand their professional networks and make valuable connections that often lead to future internships and employment after graduation. Most importantly, I find that students at all stages of study who engage in a series of very purposeful informational interviews gain the confidence to make decisions about their own career direction and take actions that prepare them for specific jobs after graduation.

SUSAN MARTIN, Program Director, PhD Career & Professional Development, University of Maryland. Photo courtesy of Susan Martin.

SO WHAT EXACTLY IS AN INFORMATIONAL INTERVIEW?

An informational interview is a 15- to 20-minute structured phone or in-person conversation with someone about their career path, possible job titles, or a particular company or industry. You take the initiative to set up the interview in advance by email and are prepared with a short list of specific questions you want to ask. Informational interviews are focused on learning more about the day-to-day responsibilities of different types of jobs, typical career trajectories, and the challenges and rewards of different occupations and work environments. An extensive list of 200 possible informational interview questions can be found at: **https://www.livecareer.com/quintessential/informational-interview-questions**. Your school's career center website is also likely a great resource for advice about how to set up and conduct informational interviews. At the end of each interview, be sure to ask if your interviewee recommends anyone else for you to speak with—acquiring and following up with this contact is how your network will expand.

The ultimate goal of each interview is to learn new information and gain a referral to someone new. They should NOT focus on asking for or finding a job.

I strongly suggest that you conduct multiple informational interviews throughout every year of your studies. Start with people you know—faculty members, high school teachers, family friends, parents of friends—to practice setting up and conducting the interviews. Over time, and as you become comfortable with the process, use LinkedIn and alumni networking tools at your school to reach out to people you don't know at all.

For more information, explore SPS's online Careers Toolbox: **https://www.spsnational.org/careerstoolbox**. It provides a step-by-step road map and eight specific tools for exploring common career options, effectively searching for employment, and choosing meaningful work. Tool #2 is wholly dedicated to informational interviews and is very user-friendly. Use these materials to get started. Faculty and advisers will also find these materials useful as they ask students that important question, "So what are your plans for after graduation?" //

Get Prepared for a 21st Century Career

by Kendra Redmond, Contributing Writer

Physics students heading down the path to becoming professors, researchers, engineers, teachers, programmers, and other professionals in the modern age are entering a diverse and exciting employment landscape—a landscape that many feel unprepared to navigate.

What skills and knowledge should the next generation of undergraduate physics degree holders possess to be well prepared for a diverse set of careers?

This is the question posed to the Joint Task Force on Undergraduate Physics Programs (J-TUPP), a group of leaders in physics academia, industry, and education that was convened in 2014 by the American Association of Physics Teachers and the American Physical Society and supported by the National Science Foundation.

J-TUPP tackled this question by synthesizing information from an array of reports and studies that address the career paths taken by physics bachelor's degree recipients and the skills and knowledge valued by today's employers. Their findings are detailed in a new report, *Phys21: Preparing Physics Students for 21st-Century Careers.*

Aimed primarily at physics department leaders, the report compiles the knowledge, skills, and attitudes that graduates need for successful careers; learning goals that physics departments can adopt to promote their graduates' success; and descriptions of ways that physics departments, professional societies, and funding agencies can ensure that those learning goals are met. It also highlights why paying attention to career preparation is important in the first place—the ways in which doing so can enrich and diversify departments, empower students, and support local communities.

Phys21 doesn't promote overhauling core physics content; rather, it suggests a variety of ways in which departments can intentionally incorporate skills like technical writing, project management, teamwork, and computer programming into existing courses while using industry-standard software. To this end, the report includes case studies of physics departments of different sizes and scopes already incorporating these skills into the major in various ways.

"To better prepare students in this way does not require that a department abandon the rigorous technical education that physicists take pride in," write co-chairs Paula Heron (University of Washington) and Laurie McNeil (University of North Carolina at Chapel Hill) in the report. "It does, however, require that physics faculty members become informed about the skills and knowledge valued by potential employers of their graduates, and that departments make appropriate modifications to curricular and co-curricular aspects of their programs."

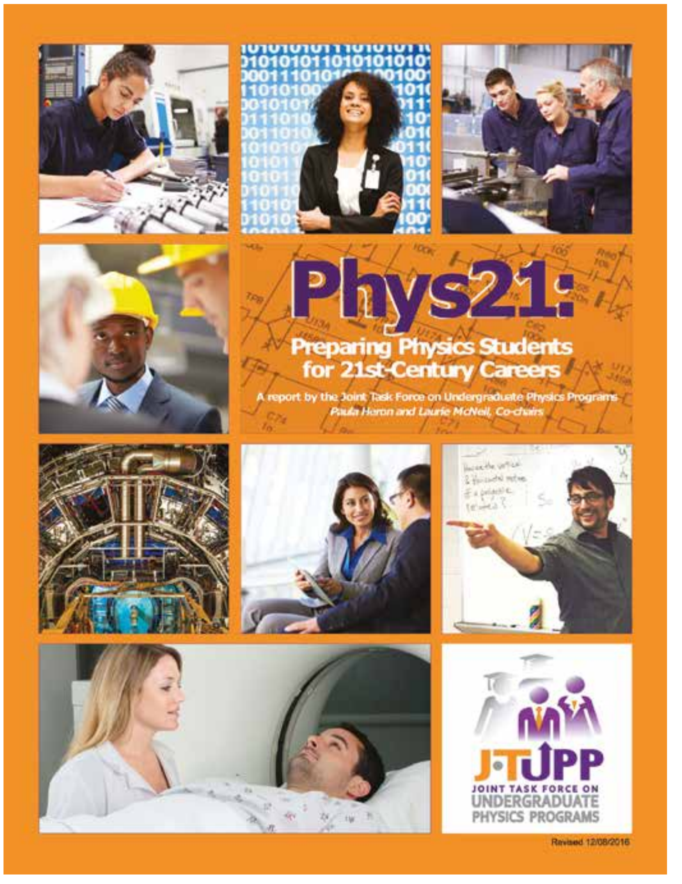


Image by the American Physical Society (CC BY 4.0).

If you want to be well prepared for the exciting career opportunities that await physics graduates, get informed and take action! Even as a student, you can...

- Put *Phys21* in the hands and in-boxes of your department leaders.
- Browse the report and identify specific learning goals and activities to incorporate into your SPS chapter activities.
- Spread the word about this report—share it with your classmates, print out copies for your physics lounge, and invite a J-TUPP representative to talk to your department or at your local zone meeting.
- Read through the sections highlighting the skills valued by employers. If you aren't already developing these skills, seek out opportunities to do so. For example, invite industry speakers to participate in SPS activities, take a business class, or choose a research project with a commercial component.

Download *Phys21* at http://www.compadre.org/jtupp/. //

Sharing the Science of Shadows

by Anna Faretty and Michaela Collins, SPS Members, Kutztown University

This year, Kutztown University's Society of Physics Students (KUSPS) chapter collaborated with Pilobolus, an internationally acclaimed modern dance group. Pilobolus performed their show *Shadowland* at KU in February. It is a dramatic, surreal, and comedic story of a young girl's world as she comes of age. During *Shadowland*, the Pilobolus performers use a mixture of techniques to tell the story, including multimedia and shadow projections.

While preparing for the show, the campus organization that brings in performances such as *Shadowland*, KU Presents!, contacted our chapter about putting together a workshop on the science of shadows. We agreed and created an educational experience for the audience.

KUSPS students presented a workshop before the show that brought the science of light and shadows to an audience of elementary and high school students. Because shadows require light, we discussed the properties of reflection, refraction, interference, and diffraction, but the focus of our presentation was the science of shadows. Our workshop included a discussion on the parts of a shadow, how distance can affect and alter the scale of a shadow, and how different colored shadows are created. After the workshop, the audience was able to appreciate *Shadowland* in a new light. We enjoyed sharing science with our community and working with Pilobolus to enhance their show.

This is our chapter's first outreach event on light and shadows but our second event in conjunction with an arts performance. In 2015, we presented a series of wave demonstrations related to the physics of music before a performance by William Close and the Earth Harp Collective, a group that creates music using instruments with 1,000-foot strings. //

TOP: KUSPS advisor Dr. Paul V. Quinn and members of the chapter presented a workshop on the science of shadows before *Shadowland*. Photo courtesy of KUSPS.

MIDDLE LEFT: During the workshop, KUSPS used a shadow box to demonstrate how distance can affect and alter the scale of a shadow. Photo courtesy of KUSPS.

BOTTOM LEFT: For more information on Pilobolus and *Shadowland*, visit www.pilobolus.org. Photo courtesy of Pilobolus.

FEATURE

Science and a sense of discovery are meant to be shared far and wide. Luckily, the benefits of science outreach are not exclusive to the general public. We all have much to gain by bringing science into our communities. Through sharing science with others in the public, we can improve our interpersonal skills, deepen our understanding of physics, and better prepare for careers in a wide variety of fields. As an experimental science, physics asks us to explore and question the world around us. Solving problems and engaging with the unknown to achieve a better understanding are powerful tools in many career fields.

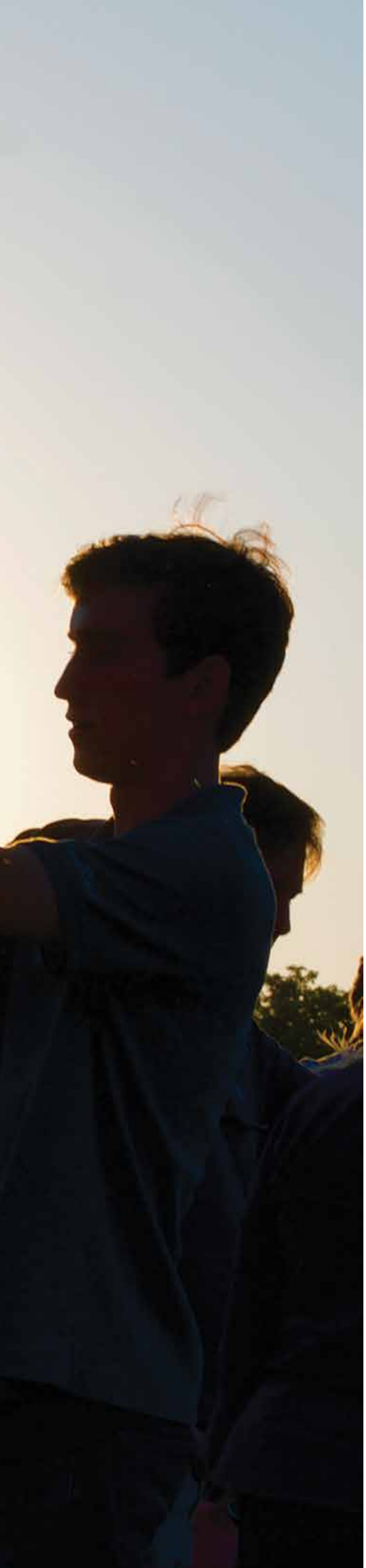
Specifically, engaging nonscientists can strengthen one's own knowledge and skills in profound ways. Effective scientific outreach requires drafting a narrative, reducing jargon, and identifying the key concept in a short period of time. This process lets us draw better logical connections by helping us identify what is important. Members of the public, especially children, ask incredibly challenging questions that require critical thinking to answer. Interacting with the public is a learning experience and just as important as lectures, homework, and research.

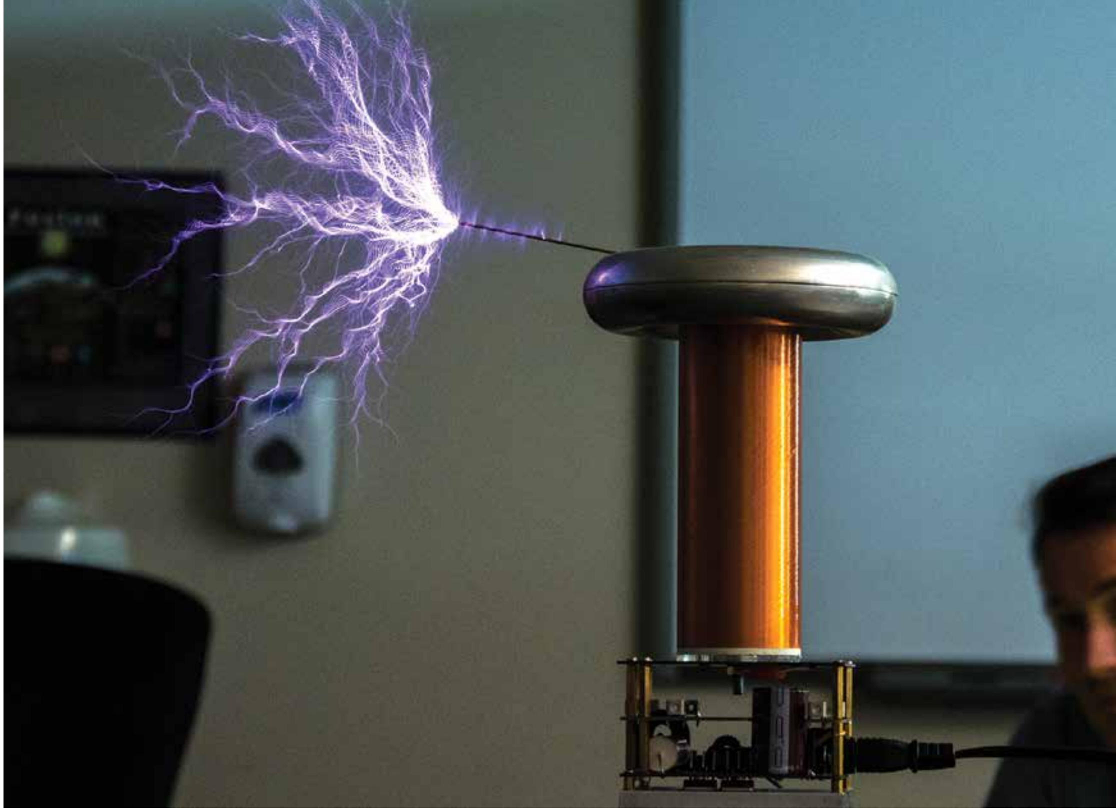
Engaging in outreach is an investment in yourself and your community. Regardless of your future career, communicating your ideas to those with different backgrounds will be essential. Outreach is also an investment in science itself. Strong public interest is necessary for thoughtful science policy (and funding). Through positive interactions with scientists, our society at-large becomes more invested in understanding our shared experience and increasing our knowledge.

To improve your knowledge, further develop your communication skills, and create positive relationships with your community, check out the activities on the next few pages. They are designed to be copied and used! //

INTRO: Exploring OUTREACH

by Jacob M. Robertson, 2017 SPS SOCK Intern, Austin Peay State University, and
Brad R. Conrad, PhD, Director, Society of Physics Students & Sigma Pi Sigma (ΣΠΣ)





LEFT: Volunteer at Astronomy on the National Mall in Washington, DC prepares telescope for participant observing during annual outreach event.

TOP: A singing tesla coil produces musical tones by modulating the spark output.

BOTTOM LEFT: Volunteers assist with a high-altitude balloon launch.

BOTTOM RIGHT: A student learns about conservation of angular momentum using a spinning wheel and chair. Photos courtesy of Dominic Critchlow, Austin Peay State University.

You can download more outreach demonstrations by topic and for all audiences by visiting

https://www.spsnational.org/programs/outreach/demonstrations

The outreach demos featured in this issue were collaboratively prepared by editor Rachel Kaufman, the 2017 SPS SOCK interns Jacob Robertson and Zakary Noel, and the SPS National staff. A special shout-out goes to 2011 SPS SOCK interns Erin Grace and Amanda Palchak for developing the Mystery Box activity (page 18) and to the 2008 SPS SOCK interns Mary Mills and Jenna Smith for their take on the Straw Reed Instrument activity (page 16).

FEATURE

Black Holes in THE KEY OF B♭

This activity lets students learn more about the universe and how astronomers study it. A bit of math is required, so this is better for more advanced students.

Note: This demonstration has been adapted from NASA's Chandra Observatory. You can find more information at http://chandra.harvard.edu/learn_cxc.html.

MATERIALS:

Millimeter-scaled rulers, paper, and pencils.

INSTRUCTIONS:

Give students a copy of the images and a ruler. Tell them this story:

> The Chandra X-Ray Observatory took these images in 2003 of a massive black hole in the Perseus galaxy cluster, 250 million light-years away.
>
> Scientists did not expect to see the black hole, but they did expect to see the hot gas in the core of the cluster, heated to a million degrees and visible in the X-ray spectrum. However, instead of a blob of gas, they saw a series of concentric rings (more visible in the lower image, which has been enhanced), which astronomers determined to be sound waves. That's right: This black hole is "singing" in space.

ASK THEM THE FOLLOWING QUESTIONS:

1) The galaxy in the image has a physical width of 350,000 light years. What is the scale of the image in light years per millimeter?
2) Based on the lower image, how far apart are the crests of the sound wave in millimeters?
3) What is the wavelength of the sound in light-years?
4) The wavelength of middle C on a piano is 1.3 meters. If 1 light-year is the distance light travels in one year, what is the distance between waves in meters?
5) Each successively lower octave is twice the wavelength of the previous one. How many octaves below middle C is the sound given off by the black hole?
6) Now, use what you've learned. If we use the entire earth as a detector, what is the lowest note we could observe? That is, how many octaves below middle C?

COMMON QUESTIONS TO EXPECT:

Can we hear the black hole?

No! Sound is a longitudinal wave and needs a medium. In this case it's hot gas. Since the gas doesn't reach us, because the cluster is 250 million light-years away, we cannot detect it.

In addition, the sound produced is at such a low frequency that it's far beyond the limits of human hearing.

Why is it doing this?

Astronomers believe that bubbles in the cluster gas are blown out by jets from a supermassive black hole in the center. Those bubbles push against the gas, creating a pair of sound waves.

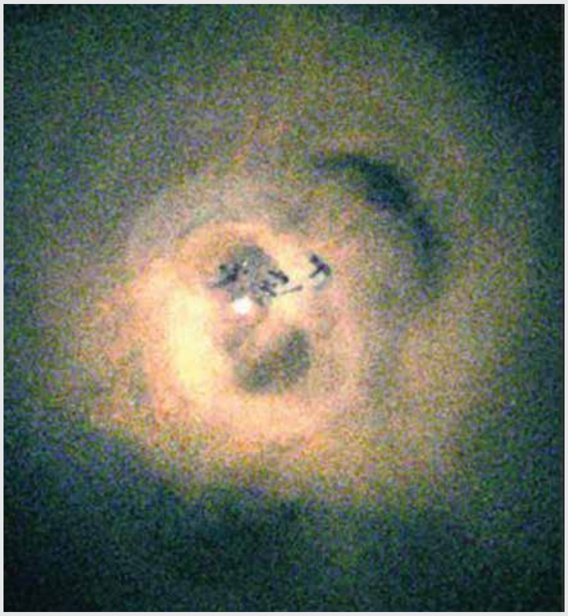
The waves also provide a source of energy for keeping the gas from cooling too much, which prevents star formation in the central galaxy. Scientists believe that to offset cooling in the cluster, it had to have been "singing" the same note for 2.5 billion years.

PHYSICS:

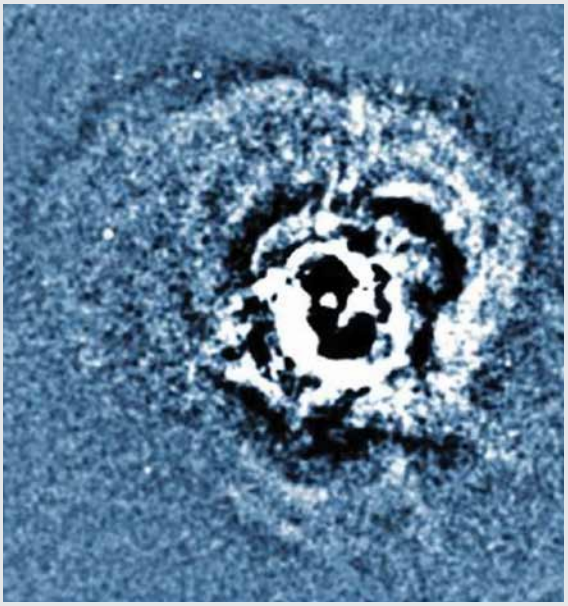
Multiply the scale you found in question 1 and the ruler distance between waves you measured in question 2. This will give you a wavelength in light-years, or the answer to question 3. A light-year is the distance light travels in one year. Thus in one year, light would travel 3×10^8 m/s $\cdot \pi \times 10^7$ s $\approx 9 \times 10^{15}$ m. *Note: We are approximating there are π times 10^7 seconds in a year.* A distance between waves of ~3×10^4 light-years, or ~3×10^{20} m, is reasonable.

Once you have the distance between waves in meters, we want to know how many times you need to double 1.3 m (the wavelength of middle C on a piano) to get the length measured in question 2. Students can do this with calculators, on paper, or spreadsheets, but a result around 68 octaves below middle C is correct. *Astronomers even calculated that the "note" the cluster is "singing" is a B-flat.*

Bonus question left to the reader: If a piano has just over 7 octaves and is 165 cm wide, how big of a piano would you need to hit the note Chandra detected?



CHANDRA X-RAY (3-COLOR)



CHANDRA X-RAY (SOUND WAVES)

A 53-HOUR CHANDRA OBSERVATION of the central region of the Perseus Galaxy Cluster (top) has revealed wavelike features (bottom) that appear to be sound waves. Make photocopies so all students have one, or you can print off copies of the image at http://chandra.si.edu/photo/2003/perseus/.

Image credit - NASA/CXC/IoA/A.Fabian et al.

FEATURE

Straw Reed INSTRUMENT

This experiment uses inexpensive materials to teach grades 6-12 and the general public about acoustics and the physics of sound. It is ideal for many different-sized groups and limited budgets. Explanations can be adapted based on the education background of the audience.

MATERIALS:

Scissors and plastic soda straws (two per participant recommended).

INSTRUCTIONS:

1) Gently flatten the last 3–5 cm of a straw as seen in Figure 1. Cut the sides at an angle as shown in Figure 2.
2) Gently blow through the cut end of the straw until a sound is heard. If you did it right, you'll hear a broadband buzzing sound with lots of harmonics. This is the sound of the ends acting as a double reed, just like an oboe.

   Before your outreach event, practice these two steps until you can make and play a straw oboe without a hitch. It's helpful to bring a working example.
3) If time allows, have participants modify their instruments by attaching a second straw or cutting a small hole in the straw. Lengthening the straw will lower the pitch of your instrument, while adding holes will raise the pitch (unless it's covered by a finger) by effectively shortening the resonating tube.

FIGURE 1: The original straw (left) and the flattened straw (right).

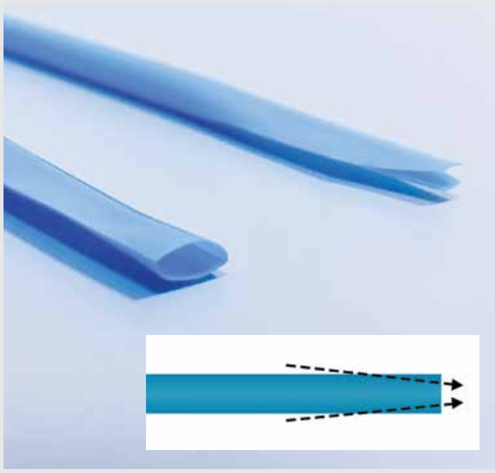


FIGURE 2: The flattened straw (left) and the cut straw (right). Cut the sides at an angle as shown in the inset. Photos courtesy of Jacob Robertson and Zakary Noel, 2017 SPS SOCK interns.

PHYSICS:

The straw acts as a closed, cylindrical resonator with a sound generator at the end (the triangular end). The tube length defines the resonance frequency of the straw, while the triangular cut end acts as a double-reed sound generator, which makes sound at many frequencies. The frequencies produced by the double reed that match the resonance frequencies of the pipe resonate and become the sounds we clearly hear. The base frequency is related to the length of the straw through the generalized wave relationship: $\upsilon = f\lambda$ Eq (1)

where υ is the wave speed, f is the frequency of the wave, and λ is the wavelength. In this case, the speed of sound in air is ~340 m/s, and the audible range for humans is roughly 20 Hz–20 kHz. The effective length of the instrument defines the wavelength λ, which defines the base frequency we hear.

This straw has one end that is open to atmospheric pressure, while the end with the reeds acts as a closed end. Similar to an oboe, this straw will have resonant frequencies that are multiples of odd whole numbers, because the pressure boundary conditions demand that one pipe end must be a node while the other pipe end must be an antinode. The open end can allow air to move in and out (longitudinal air waves) but does not allow pressure variation because it is open to atmosphere. The triangular closed end (reeds) cannot allow air motion when the reeds are closed together but can allow air pressure oscillations. Several references have been published that explain the physics of this process in more detail and can be studied if you want to understand the acoustics at a deeper level, including why a straw has resonant frequencies.[1-3]

EXPLANATION:

Target your explanations to the age and experience level of the group you're working with. Younger children will understand that the V-shaped end acts as a reed because they can feel it vibrate. Note that the length of the tube adjusts the timbre, or frequencies of the sound produced. Have several straws of different lengths on hand to demonstrate this concept.

If working with older members of the public, spend some time explaining that either extending the straw or cutting small holes makes the straw effectively longer or shorter, causing lower or higher pitches.

If working with college students, work through a back-of-the-envelope calculation about what base pitch should come out of the straw for a given length.

COMMON QUESTIONS TO EXPECT:

Does the size of the hole affect the sound?
Very much so. Small holes effectively make the tube a little shorter, while a large hole will effectively make the hole the new end of the tube. Read more on this effect here.[4]

Why isn't mine working?
It takes some practice and work to make a sound for the first time, as you need the triangular-shaped plastic ends to vibrate well. Bring extra straws so participants can try again!

Will this work with other materials?
Yes! It turns out that you could put a reed on almost any pipe and it will work in a similar way. This experiment is nice because you can make the reed and pipe as one unit very quickly. A cool demonstration is to hollow out a carrot and put the straw or actual reed in the end of the carrot to make a carrot-oboe (carroboe?)!

LEARN MORE:

https://www.spsnational.org/programs/outreach/strawreed

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1. N. H. Fletcher and T. D. Rossing, *The Physics of Musical Instruments*, 2nd ed (Springer Verlag, New York, NY, 1998), chapters 15-16.
2. T. D. Rossing, F. R. Moore, and P. A. Wheeler, *The Science of Sound*, 3rd ed (Addison-Wesley, New York, NY, 2002), Chapters 3 and 12.
3. N. H. Fletcher, *Annual Review of Fluid Mechanics* 11, 123-146 (1979).
4. A. H. Benade, *Fundamentals of Musical Instruments*, 2nd ed. rev. (Dover, New York, NY, 1990), chapters 21-22.

FEATURE

Mystery BOX

This demo for younger students replicates the famous gold foil experiment first conducted by Ernest Rutherford to study the nuclei of atoms. This experiment makes it possible to learn about atomic structure at the macroscopic scale.

MATERIALS:

Cardboard box, a ramp with multiple tracks, marbles, paper, Sharpie markers, and objects that fit under a box, such as: a small rectangular object like a deck of cards, a round object like a mug, something hollow sounding, and something long and narrow.

INSTRUCTIONS:

Cut a rectangle out of each side of the box as seen in Figure 1. Now the box has four "legs" and objects can pass underneath. Hide an object under the box.

Set up the ramp so it leads into the box as shown in Figure 2. Ask students to roll marbles down the ramp and record (sketch) their trajectories. Have students mark each marble's path with a Sharpie. See if the students can guess what's in the box based on the marble paths! After the students have guessed, you can lift the box to reveal the object.

This experiment simulates an experiment done by E. Rutherford[1,2]: By firing a beam of alpha particles at a gold foil sheet, he concluded that there were tiny nuclei in atoms.

EXPLANATION:

The object in the box represents the interior of an atom. Just as an atomic nucleus is too small for us to see, we can't see inside the box (until the lid is lifted up), but we can make educated guesses about the contents of the box by observing what happens to the marbles. By firing particles (marbles) at the atom (box) and tracing the pathways, we can learn about the interior of the atom.

COMMON QUESTIONS TO EXPECT:

Why can't we just look inside the box to get the "right" answer?
Sometimes in physics we study things that are very small, and we can't "just look inside" to get the right answer. In other words, there's no peeking in real physics! Even today, with a hundred years of technology, we still can't "see" the building blocks that make up atomic nuclei. So we have to get creative and come up with ways to learn "what's inside the box" without looking.

PHYSICS:

At the beginning of the 20th century, the current atomic model was J. J. Thomson's "plum pudding" model. He theorized, "Atoms of the elements consist of a number of negatively electrified corpuscles enclosed in a sphere of uniform positive electrification." His corpuscles (or electrons) were like raisins in a pudding or sea of positive charge.

According to the popular plum pudding model, the alpha particles should have experienced only small angle deflections from the corpuscles. However, the experimental results were that a small percentage (only 1 in 20,000!) of the alpha particles were deflected at large angles, some even greater than 90°.[1,2] Since a small fraction are deflected, we know the nucleus must be very small (~2 fm).

Rutherford commented on the results:

> It was quite the most incredible event that has ever happened to me in my life. It was almost as incredible as if you fired a 15-inch shell at a piece of tissue paper and it came back and hit you. . . . When I made calculations I saw that it was impossible to get anything of that order of magnitude unless you took a system in which the greater part of the mass of the atom was concentrated in a minute nucleus. It was then that I had the idea of an atom with a minute massive center, carrying a charge.

Thus Rutherford was able to definitively reject the plum pudding model in his 1911 paper[3] on his results. Instead he hypothesized the existence of a "central charge" where almost all of the atom's mass was concentrated, which later became known as the nucleus.

LEARN MORE:

http://chemed.chem.purdue.edu/genchem/history/gold.html

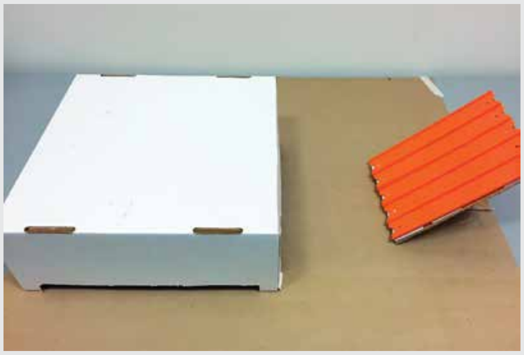

FIGURE 1: The mystery object, (in this case a coffee mug, revealed in Figure 3), placed on a large sheet of paper with the box and ramp.

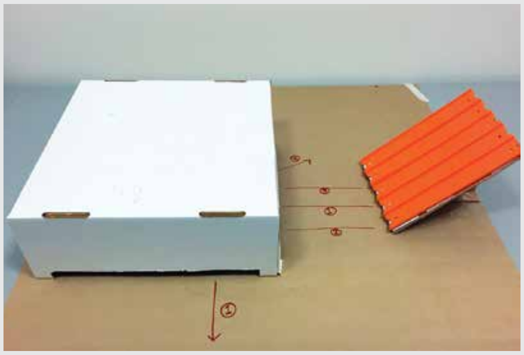

FIGURE 2: With each roll, participants use a marker to trace the marble's path as it travels in and out of the box.

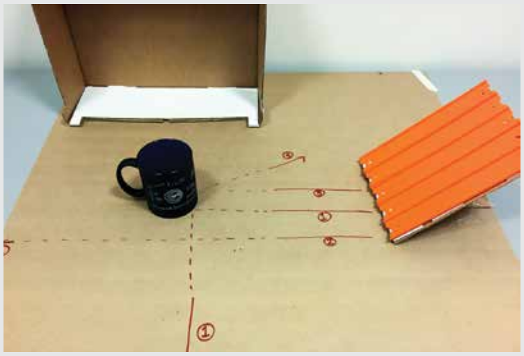

FIGURE 3: After participants guess what is under the box, lift to reveal the object.

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1. K. S. Krane, *Modern Physics*, 3rd ed. (Wiley, USA, 2012).
2. S. Thornton and A. Rex, *Modern Physics for Scientists and Engineers*, 4th ed. (Cengage Learning, 2013).
3. E. Rutherford, "The Scattering of α and β Particles by Matter and the Structure of the Atom," *Philosophical Magazine*, series 6, vol. 21, May 1911, pp. 669-688.

FEATURE

Simple MOTOR

This experiment will show students how to build a simple electric motor. This is best for students twelve and older as it requires some delicate work.

MATERIALS:

For each motor you'll need one C battery, a small but strong magnet, about three feet of magnet wire (buy it at Radio Shack, online, or any hardware store), two safety pins, a rubber band, sticky putty, and a small piece of sandpaper. Magnet wire has a plastic coating.

INSTRUCTIONS:

Wrap the wire around a circular object (like the battery, or better yet, a pen or pencil) and then slide it off to create a small coil (diameter ~1 cm), leaving the two ends sticking out as shown in Figures 1 and 2. We next need to remove the insulation from part of the ends. On one end, sand off the coating all the way around the wire. On the other end, sand the bottom side of the wire only.

Next, assemble the motor as shown in Figure 3. The safety pins are attached to the battery with the rubber band and the wire coil ends go through the holes in the ends of the safety pins. Here, we used a little sticky putty to hold the battery still on the table. Put the magnet on top of the battery, under the coil. Give your coil a little spin, and it should continue to spin on its own. (If it doesn't work, try spinning it the opposite direction.) You've made a motor!

EXPLANATION:

When electricity is passed through a wire coil (as you are doing when you connect the coil to the battery), you create an electromagnetic field, which pushes the coil away from the magnet.[1,2] When you give the coil a spin, since one side of the wire is insulated, you break the circuit briefly, so the coil continues to rotate using its momentum. When the circuit is complete again, the magnetic field once again repels the coil, so it keeps spinning. The motor can continue to spin until the battery is dead!

LEARN MORE:

Instructions for building an even simpler motor using a battery, a magnet, wire, and a drywall screw can be found here. Watch out with this one, and use eye protection as the screw could go flying.
http://www.evilmadscientist.com/2006/how-to-make-the-simplest-electric-motor/

Instructions for building a more advanced motor that doesn't require a push to get started can be found in *The Physics Teacher*, the journal from AAPT, "Development of a New Method for Assembling a Bipolar DC Motor as a Teaching Material."
http://aapt.scitation.org/doi/abs/10.1119/1.4981037

PHYSICS:

An electrical current through any conductor creates a magnetic field. This was discovered (some say by accident) by Hans Christian Oersted in 1820 when he noticed a nearby compass needle was deflected when he turned on his electrical equipment. You can see the same effect with your coil circuit and a compass.[1,2]

Wrapping the wire into a coil increases the strength of the magnetic field, so long as the moment of inertia remains small.

The principles that allow this motor to work are the same ones that govern all motors. These motors all turn electromagnetic energy into kinetic energy. Generators work the opposite way, by turning kinetic energy into electromagnetic energy (and in fact, you can turn motors into generators and vice versa, although sometimes it takes a little work).

COMMON QUESTIONS TO EXPECT:

Why isn't it working?
This relatively simple motor can take some patience. The answer to this most common question could be a number of issues. Try some troubleshooting:

- Make sure your safety pins have good contact with the battery terminals.
- Make sure you didn't sand off too much of the wire insulation—one end needs to have enough insulation on one side that the circuit is broken as the coil spins.
- If the coil is leaning too far to one side, you may need to rewrap it so it's more symmetrical.
- Try spinning the coil the other direction.

REFERENCES

1. R. P. Feynman, R. B. Leighton, and L. L. Sands, *The Feynman Lectures*, vol. 1 (Addison-Wesley, 1963-1965), chapter 16.
2. R. D. Knight, B. Jones, and S. Field, *College Physics*, 3rd ed. (Pearson, San Francisco, CA, 2014).

FIGURE 1: Wrap the coil around a circular object like a marker.

FIGURE 2: Slide the wire off the pen to create a coil. Diameter is ~1 cm.

FIGURE 3: The fully assembled electric motor. Photos courtesy of Jacob Robertson and Zakary Noel, 2017 SPS SOCK interns.

SPECIAL FEATURE

March For Science ENERGIZES SPS MEMBERS NATIONWIDE

by Rachel Kaufman, Editor

On April 22, hundreds of thousands of people—scientists among them, but also everyday citizens—took to the streets for a cause that isn't often a part of political protest: science.

The March for Science was actually over 500 Marches for Science, happening in cities all over the world, on every continent but Antarctica.

Scientists, even those who often don't typically participate in political demonstrations, flocked to get involved. After all, many said, supporting science isn't a partisan issue.

SPS also got involved. The National Council voted on April 12 to "encourage our members to take advantage of this occasion to show their support and passion for science and demonstrate civic agency in furthering these aims." (Read the full statement at **https://www.spsnational.org/news/sps-statement-march-science**.)

And get involved you did! We heard from SPS members across the country who attended or even helped organize local marches. On the next page are some words from two of them, Mark Samuel Abbott and Alex Leith.

TOP: March participants gather in front of the Minnesota state capitol in Saint Paul, MN. Photo courtesy of Kendra Redmond.

MIDDLE LEFT: Contributing writer, Kendra Redmond, shows her support for science at the Minnesota March for Science. Photo courtesy of Kendra Redmond.

MIDDLE RIGHT: Participants included people of all ages at the Minnesota March. Photo courtesy of Kendra Redmond.

BOTTOM: Members of the SPS National Office and APS members show their support for the March in Washington, DC. Photo courtesy of Brad R. Conrad.

Mark Samuel Abbott, SPS president at California State University, Sacramento, marched in Sacramento, CA

The March for Science was a formative day for me. Before the march, I had a tendency to view my field in a vacuum (as we physicists are wont to do). I looked at my physics department, proud that it has almost 100 majors, and considered my community relatively large yet fairly isolated.

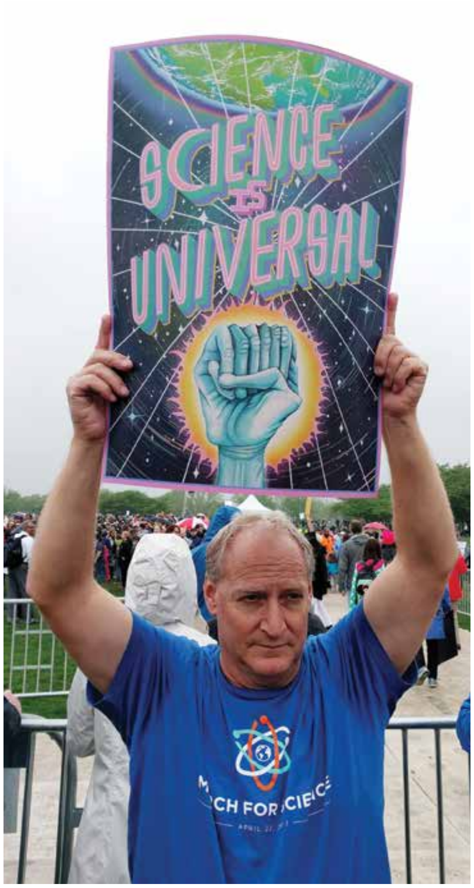
In my general education (GE) classes, no one wanted to hear about science, let alone physics. I would bring up physics at every opportunity because I just couldn't hold my passion in, and I was under the impression that I was relatively alone in that regard.

But at the march I discovered that my community is so much larger than I thought it was. I saw thousands of people demonstrating their love for science in a peaceful way, and it was awe-inspiring. I discovered that I am not alone in my love for science and that there are thousands of people around me every day that would march for my cause and love doing it. I was so worried about support for the sciences recently because it seems like scientists have been rather put upon, but the march reassured me that the public loves science as much as I do.

I thought that public opinion had shifted to be against science, and it honestly had been discouraging me from following my dreams to become a physicist. But I've changed my mind. The march renewed a vigor in me that reminds me of when I was a bright-eyed and bushy-tailed freshman. I feel so grateful that I had the opportunity to participate in this amazing event and will remember it always.

Alex Leith, SPS member at Metropolitan State University of Denver, marched (and helped organize) in Denver, CO

Like most of the organizers in Denver, I joined in response to President Donald Trump's proposed cuts to the EPA and other scientific institutions.



Many people in Colorado rely on companies and organizations like Lockheed Martin, NCAR, NREL, and many others for employment. I have friends who were not sure that they could get jobs at these institutions due to these proposed cuts! Like many others, we took to the streets to express our concerns.

The day of the march started off rainy and ominous. None of us were certain that people would come. As our teach-in groups—scientists, educators, and science-motivated institutions like the Nature Conservancy and Dinosaur Ridge—started showing up, the sun came out. And the people of Denver began showing up in force.

Denver was tied with New York City as the fourth most populous march in the world, with over 20,000 people in attendance! The Denver chief of police commented to us that the march was "the calmest and most-organized protest he has ever seen." We left Civic Center Park cleaner than we found it, and all of our equipment and people were out of the park just three hours after the March ended. This experience shows what can happen when you get a group of scientists behind the wheel of public discourse.

The community is not satisfied with leaving the event as our sole contribution to science and politics. We hope to be a voice for scientifically backed policies. The organizers and I are currently registered as an LLC and we plan to reorganize ourselves into a 501(c)(3). Looking forward, we hope to offer our services as scientists to consult and connect other scientists around Colorado. As we chanted on April 22, "What do we want? Scientifically backed policies! When do we want it? After peer review!" //

TOP LEFT: Mark Abbott (pictured left) poses with SPS members of California State University, Sacramento at the Sacramento March. Photo courtesy of Mark Abbott.

BOTTOM LEFT: An APS member demonstrates his love for science during the Washington, DC March. Photo courtesy of the American Physical Society.

TOP RIGHT: Participants await the next speaker in front of the Washington, DC main stage. Photo courtesy of the American Physical Society.

BOTTOM RIGHT: A participant shows her support for nuclear scientists at the Denver March. Photo courtesy of Alex Leith.

Science Policy AND CONDUCTING A CONGRESSIONAL VISIT

by Sally Dagher, SPS Member and Former Zone 7 Associate Zone Councilor, Kettering University

As an associate zone councilor (AZC), I was given the opportunity to participate in Science–Engineering–Technology (SET) Congressional Visits Day and speak with my elected officials about topics that I care deeply about. In my case, I care about funding national science programs. Being a woman in physics, I often struggled with imposter syndrome, where I felt as if I did not belong. After attending a Conference for Undergraduate Women in Physics (CUWiP), I attended workshops that touched on these struggles of being a minority in STEM and how to overcome them. These workshops were a crucial step in continuing my career in STEM, but they wouldn't have been possible without funding from the National Science Foundation (NSF).

When I met with my representatives and senators, I wanted to get the message across that funding science programs through organizations like the NSF is crucial to maintaining a diverse generation of scientists and engineers. My job was to give a face to a cause. I told them my personal story about how conferences like CUWiP saved my career as a minority in STEM. It is important for politicians to understand the personal impact their decisions have on their constituents.

I found that the representatives were genuinely intrigued by my experiences, regardless of their political views. My advice is to take advantage of this emotional connection. Also, be prepared and enthusiastic. The act of reaching out to politicians can be intimidating at first, but be confident in your story and passionate about your cause!

TOP: SPS associate zone councilors Hannah Hamilton and Nick DePorzio are pictured in front of the US Capitol Building during the 2017 Congressional Visits Day, organized by the Science–Engineering–Technology (SET) Working Group. Photo by Kerry Kidwell-Slak.

LEFT: Sally Dagher. Photo courtesy of Sally Dagher.

Part of being in a professional association like SPS or one of AIP's Member Societies means that you have an amplified voice when it comes to reaching out to elected officials. Be sure to take advantage of this important member benefit and support your association's advocacy efforts.

HOW TO ARRANGE A CONGRESSIONAL VISIT DAY:

1

FIRST THINGS FIRST:
Pick a date. If you are going to meet your representatives in DC, be sure that Congress is in session. For an up-to-date calendar, visit https://www.congress.gov/days-in-session. You can also meet with your elected officials in their home office. Visit their website for more information.

2

AT LEAST 6 WEEKS OUT:

- Begin to consider what your message will be. Is there a specific bill you would like your elected officials to vote a certain way on or co-sponsor? Can you provide specific examples of ways they can impact an issue you face?
- Order business cards for yourself, including your name, affiliations, email, and phone number.
- Make your travel arrangements.

3

ABOUT 3 WEEKS OUT:
Begin calling and/or emailing offices. (You can find your representatives' phone numbers on their websites.) A good phone script would be:

"Good morning/afternoon.
My name is [Name], I live in [City, State], and I am a constituent of [Senator/Rep's name]. I am calling today as a member of the Society of Physics Students chapter at [School name]. I will be in Washington, DC, on [Dates] and would like to speak with the scheduler about setting up a meeting at [Time]. Can you tell me the scheduler's name and connect me?"

If you are connected
Restate the information above and describe the issue you would like to talk about (e.g., "I would like to speak with the [Senator/Rep] about the importance of funding for Research Experiences for Undergraduates via the National Science Foundation.") Don't be disappointed if your senator or representative is unavailable. Ask if you can meet with their staff person on science issues instead.

If they are not able to connect you
Get the name and email address of the scheduler and follow up with an email:

TO: [Scheduler]
CC: [Staff person]

SUBJECT: Constituent Meeting Request [date] at [time]

Dear [Senator, Congressman, or Congresswoman] [FULL NAME]:

My name is [FULL NAME] of [City, State where you are registered to vote], and I would like to request an appointment with you on [Date] at [Time].

I am a physics student at [University Name] and would like to speak with you about your support for the sciences and STEM education. I will be in [Washington, or City with home district office] with my fellow students and professors to raise visibility and support for science, engineering, and technology.

Thank you,
[FULL NAME]
[Phone number]
[Email address]

Start building your schedule. Allot approximately 30 minutes for each meeting.

4

TWO WEEKS OUT:

- Follow up with any of the offices you haven't heard from yet—be polite, yet persistent, and don't give up!
- Refine your elevator pitch. There are lots of resources out there on how to craft an engaging and persuasive pitch that will open the door to conversation. Think about what your specific asks will be for your elected official. Wear a clean business suit and neat, comfortable shoes.
- Consider developing a one-page "leave behind" that summarizes your key points and gives the person you are meeting with a concrete reminder of your priorities.

5

ONE WEEK OUT:

- Practice, practice, practice your elevator pitch. You should feel very comfortable with your speech and be able to give it in an engaging way without any notes.
- Follow up with any offices you have not yet heard from.

6

DAY OF:

- Eat a good breakfast, pay attention to your wardrobe, and get ready to take on Capitol Hill!
- Arrive at each of your offices a few minutes early.
- Get business cards from everyone you meet.
- Take breaks throughout the day to get food and reflect on what you've heard.
- Enjoy! This is a unique opportunity to engage with people who have been elected to serve you! Take the time to share your story, ask your questions, and know that you are making an impact on future policy.

Moriel Schottlender

BS, Physics, CUNY City College
MS, Computer Science, New York Institute of Technology

What she does:
Schottlender is a senior software engineer at Wikimedia Foundation, the non-profit that runs Wikipedia. She works on the collaboration team, developing tools for Wiki editors. On Wikipedia, that means millions of volunteer contributors who maintain the online encyclopedia that, let's be honest, most of us use daily. As an example of the type of work she does, her team recently rolled out a set of tools that help editors better identify possible vandalism.

How she got the job:
"While I was taking my bachelor's degree, I realized that I really love physics but I'm not entirely sure that I'm the best at traditional physics," Schottlender says, meaning the slow, methodic pace of doing research. But she knew she also liked coding, so she went for a master's degree in computer science. As an intern, she found the Summer of Code, a Google project that encourages (and pays) students to work on open-source projects. She proposed a project for the Wikimedia Foundation that would have created 3-D, interactive representations of physics concepts inside Wikipedia articles. Nobody was willing to supervise that project, but someone mentioned that another mentor there was looking for Hebrew speakers for a project related to languages that read from right to left. Schottlender's native language is Hebrew, so she got in. "I had no idea that [right-to-left language display on computers] was that complicated, even though I basically grew up with right-to-left language," she says. After her internship ended, she was hired part-time and came on as a full-time employee right after graduating.

Why you would want this job:
"If you're passionate about knowledge and making sure there is free access to knowledge anywhere in the world and you want to approach that with analytical thinking to solve problems," you might want to work at the Foundation. "You also need to like computers," she laughs. One thing that appealed to Schottlender about software development is the pace. Research and development both move a lot quicker than they do in traditional physics, which was a better fit for her. As a master's student, she published a paper[1] after six months of research: "I thought I was a complete fraud, because who publishes after six months? But you do in computer science."

How physics made a difference:
"When you study physics you don't just learn the subject matter. It's not just about the equations and the numbers. What you learn is how to think. You learn to analyze things. If nobody has ever modeled this before, how do I approach this? This is exactly what happens to me at work. Nobody has done something that allows users to do whatever. So how do I test it? How do I actually do it? This is physics thinking." //

1) http://ieeexplore.ieee.org/document/6845190/

Linda Hennenberg

BS, Physics, Northern Arizona University
Graduate Diploma, Science Communication, Laurentian University

What she does:
Hennenberg is the manager of extracurricular programs at the Arizona Science Center, a hands-on science museum. She runs summer and day camps for school-aged children.

How she got the job:
"When I started in college in my physics major, I wanted to go get my PhD, be a professor, a researcher, or something," she says. "But through SPS and my department I did a lot of outreach, where kids would come to our department or we would go to schools, and I thought that was way more fun than the research opportunities I tried out."

Hennenberg ultimately took a graduate program in science communications at Laurentian University in Ontario, Canada. There, she says, "a lot of the classes were based at a science museum," so she got a lot of hands-on work. After working on the floor at a museum in Nevada, she landed a position at the Arizona Science Center and worked her way up to her current position.

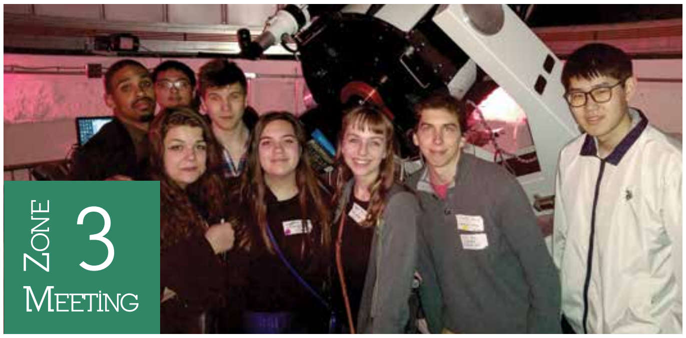
Why you would want this job:
"Working at a museum is a very rewarding job, even if you don't want it as a career for the rest of your life. A lot of museums, they also have active research programs. So there are lots of opportunities for people to do more education or more research and get a good balance."

How physics made a difference:
Hennenberg's volunteer outreach work as an undergraduate helped her learn what she wanted to do, and her knowledge of physics helps her today when developing programs and activities. "I don't have to do a whole lot of research to write those activities," she says. "We have programs about electronics and making circuits, and those are kind of easy for me to teach, because I have that knowledge." Further, she says, having a background in the scientific method helps her develop activities on any topic—she recently created a series about sharks. "And all that scientific mindset, I guess, is something I learned in college that I can definitely translate to my job." //

HOSTED BY THE UNIVERSITY OF MAINE

by Samuel Borer

With 50+ chapters, Zone 1 has often lacked a thread of community tying us together. However, this meeting brought together chapters from Maine to Massachusetts. We discussed the roles of our chapters in our departments, shared best practices for successful events, toured the Laboratory for Surface Science and Technology and the Emera Astronomy Center, and had an impactful discussion with SPS director Brad Conrad. It was a day of weaving a communal thread through our chapters and developing relationships that will extend beyond SPS. //



HOSTED BY SWARTHMORE COLLEGE

by Luke Barbano

At this year's Zone 3 meeting, attendees from five local schools participated in student-run events including research presentations, a CV/resume workshop, panels on life after graduation, a Python workshop, and Physics Jeopardy. We were honored to host Dr. Roberto Ramos (University of the Sciences) as the keynote speaker and SPS president Dr. DJ Wagner (Grove City College). The zone meeting was a rare and exciting opportunity to meaningfully interact with physics students from nearby institutions! //

HOSTED BY EMORY UNIVERSITY

by Nicholas Cuccia

Hosting this meeting was a wonderful opportunity for our chapter and our school. We introduced students from across the country to Emory's culture and physics department and treated them to planetarium shows, demonstrations, game nights, guest talks, and lab tours. It was inspiring to learn about topics as incredible as the dark void of black holes and as engaging as the flow rate of urine through mammals. Bringing the local physics community together was a great experience! //

HOSTED BY HENDERSON STATE UNIVERSITY

by Matthew Taber

Every year, Zone 10 strives to present a new facet of development within our zone meeting, such as presentation skills and teamwork. This year, our focus was fellowship. We incorporated fellowship into the meeting with events like a game night, in which we invited the zone members to play board games, video games, and card games together. Henderson's physics department has a strong sense of fellowship, and hopefully we inspired attending chapters to grow their own fellowship as well. //

TOP LEFT: Zone 1 meeting attendees. Courtesy of Samuel Borer.

TOP RIGHT: Swarthmore and University of the Sciences students at the Peter van de Kamp Observatory. Courtesy of Jackie Pezzato.

BOTTOM LEFT: Zone 6 attendees on a lab tour. Courtesy of the Emory University SPS chapter.

BOTTOM RIGHT: Zone 10 meeting attendees. Courtesy of Brian Terry.

To learn more about SPS regional zones and their meetings, visit https://www.spsnational.org/meetings/zone-meetings.

Posters, Panels, and Physics

THE APS MARCH MEETING 2017, MARCH 13-17, NEW ORLEANS, LA

by Bethany Campbell, SPS Member, University of West Florida

This was my first time attending the APS March Meeting, and I quite enjoyed it! I have previously attended CUWiP (Conferences for Undergraduate Women in Physics) at Georgia Tech, so I was very excited to finally go to a March Meeting.

I presented a poster, "Exploring K-12 Mathematics Course Progression: Implications for Collegiate Success in Florida," and also attended an informative panel on working in industry.

INDUSTRY PANEL

This panel was designed to answer questions about working in industry. We heard from Dr. Erik Lucero at Google, Mr. Raja Rajasekaran from TOPTICA Photonics, Dr. Tiffany Santos from Western Digital, Dr. Pavel Kornilovich from HP Inc., and Dr. Krysta Svore from Microsoft.

Among the questions asked:

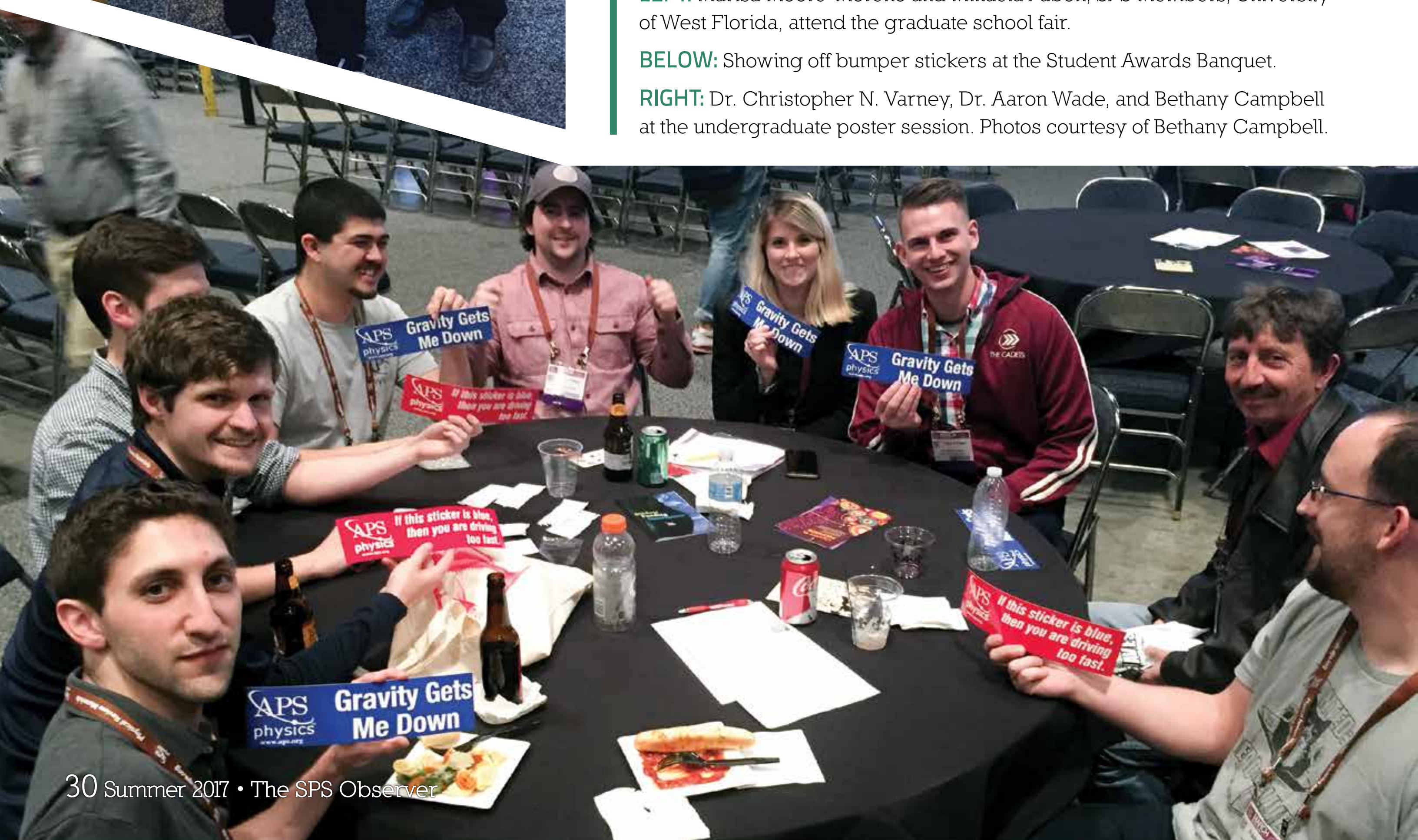
"When you do research, is your name still on your work, or is it under the company's name?"

The general consensus was that your name is still attached to the work—you are encouraged to apply for a patent and then your name will be listed as the inventor. It is difficult to publish research in journals, but panelists emphasized

LEFT: Marisa Moore-Moreno and Mikaela Pabon, SPS Members, University of West Florida, attend the graduate school fair.

BELOW: Showing off bumper stickers at the Student Awards Banquet.

RIGHT: Dr. Christopher N. Varney, Dr. Aaron Wade, and Bethany Campbell at the undergraduate poster session. Photos courtesy of Bethany Campbell.



that patents are just as valuable as papers and that it brings them great satisfaction to see their work as a tangible product in use.

"Did you feel pressured to get a PhD just because you don't have technical expertise for a job?"

Panelists emphasized that employers don't always expect you to have the exact expertise they are looking for; rather, they desire candidates that have proven they can learn and adapt.

"How valuable are post-docs before industry jobs?"

Panelists agreed that post-docs are still valuable, even if you plan on going straight into industry. Post-docs are also a good entry point into a company. Dr. Svore expressed that she felt as though she may not have been offered a permanent position had she not done a post-doc with Microsoft first. However, she also added the caveat that if one knows exactly what they want to do, perhaps a post-doc is not worth it.

"How should we decide which field to focus on?"

Panelists encouraged us to pursue whatever we are passionate about and can see ourselves spending significant time on. They emphasized that interdisciplinary research is critical and not to be afraid of getting involved in emerging fields! Dr. Steven Lambert (the session's facilitator) added that he had no idea what field he wanted to go into before he actually went into industry.

"I'm not going to graduate school. What can I expect with just a bachelor's degree in industry?"

Panelists said that the vast majority of their colleagues hold doctorate degrees. However, they also agreed your opportunities really depend on the specific company. Some companies may encourage movement and development, and may even pay for one to continue their education! While some companies, such as Microsoft, may hire many people with just a bachelor's degree, others may not.

"You all come from very prestigious universities—what about people from ordinary universities?"

As a student from an "ordinary" university, this question was of particular interest to me. The panel members all had exceptional backgrounds. The only panel member who had a response to this question was Dr. Kornilovich, who said that at HP Inc. in Oregon, they really value local people and that management wants to retain local hires. It was good to hear that major companies will hire local students. I know of companies down here in Northwest Florida that do the same, but it was slightly disheartening that there was not more feedback for us "ordinary university" students.

The remainder of the questions focused on work-life balance, the existence (or lack thereof) of the "forty-hour workweek," and opportunities for outreach and teaching. The responses were overall positive, with panel members saying that the forty-hour workweek definitely can exist, and that companies actually encourage outreach in the community through affiliate faculty positions at universities, lecture/tutorial series, and mentoring programs.

All in all, the March Meeting was a great time. Our younger undergraduates took advantage of the graduate school fair, and everyone took advantage of the technology and job expo. I'm looking forward to next year—see you in Los Angeles! //

the SPS Observer
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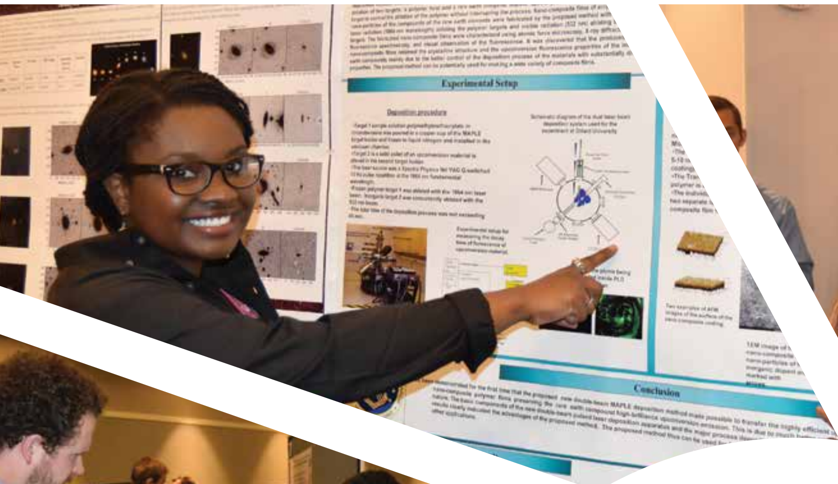

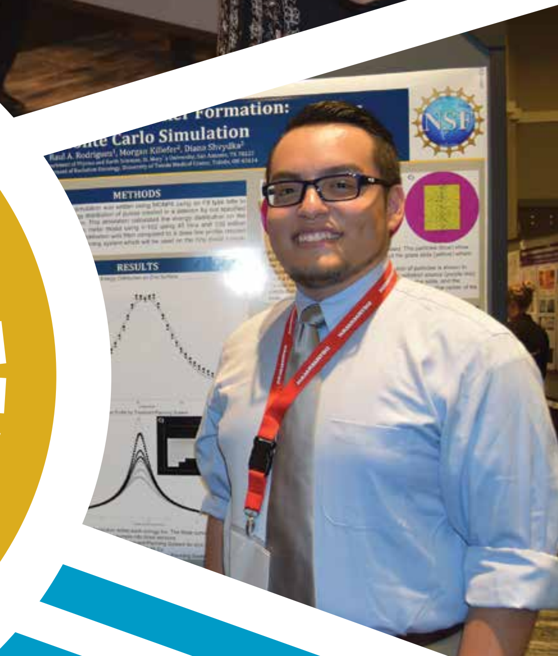

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