APS Forum on Education
FEd

Fall 2025 Newsletter

Alessandro Cunsolo, Editor

From the Past Chair

Daniel Claes, *University of Nebraska-Lincoln*

With science under attack (follow the Union of Concerned Scientists tracking of these incidents at ucs.org/resources/attacks-on-science) and research funding jeopardized, our role as educators is more important than ever. We need to rebuild the public's trust in scientific findings, promote informed decision-making by our policy leaders based on objective, reliable data, and arm our students with the means of countering misinformation. We need to develop our own communication skills to explain science as a process and a discipline, not just a body of facts.

With artificial intelligence already making inroads to the classroom we find ourselves not just addressing issues of academic dishonesty we never imagined needing to confront but growing increasingly concerned over AI thwarting on our best efforts in developing critical thinking and problem-solving skills among our students. How do we encourage students to invest time in practice and counter the seductive allure of seeing an answer worked out in sufficient detail that they're satisfied it "makes sense" and is all that they need?

With the promise of quantum computing sparking spectacular investments by federal funding agencies and major tech industries, we have a responsibility to educate the future quantum workforce by providing interdisciplinary training at all levels (grade school through professional schools) that bridge the quantum theory we've traditionally taught to the practical hands-on skills with hardware and software that will be needed.

This short list of challenges alone should impress upon you just how important the educational aspect of our role as scientists is. You do not face these challenges alone. The APS Forum on Education can help by expanding your network of scientists to include practitioners already finding creative, effective ways to meet these very challenges. You will find FEd-sponsored sessions at the APS Global Summit (next in Denver – and online – March 15-20, 2026) on these and other topics that should be of interest to you. Come find out just how much you can learn from others.

In gratitude for how much others have meant to you in your own growth as an educator, you should consider nominating worthy colleagues for a number of FEd awards. APS prizes, awards, and fellowships recognize outstanding achievements in research, education, and public service. With few exceptions, they are open to all members of the scientific community in the U.S. and abroad. As a member of the Forum on Education every year you have the opportunity to honor colleagues through nomination to

- APS Fellowship
- the Excellence in Physics Education Award (awarded by the Committee on Education)
- the APS Prize for a Faculty Member for Research in an Undergraduate Institution
- the Reichert Award for Excellence in Advanced Laboratory Instruction.

Each of these usually has a deadline of **early June**.

This spring please consider nominating colleagues for these distinctive honors signifying recognition by one's professional peers. Through its Fellowships FEd honors forum members who have made broad, significant contributions to physics education, not limited to research in physics education. Help us do that. More information can be found at

aps.org/funding-recognition/aps-fellowship/fed-fellowship.

PhysTEC Section on Teacher Preparation

Alma Robinson, *Virginia Tech*

During the 2025 PhysTEC workshop in Washington, members of the AAPT Physics Teacher Resource Agent (PTRA) program and university physics teacher educators gathered to share initiatives for physics teacher preparation and support at both the college and high school levels.

In this issue of the Physics Teacher Preparation Section, Alice Flarend and Nina Morley Daye discuss the central goals and programs offered by PTRA and invite everyone involved in physics teacher education to collaborate with PTRA to strengthen the professional development of both preservice and inservice teachers.

Jakeb Rising, a high school physics teacher and long-time PTRA member, shares his growth as a physics teacher through his involvement with PTRA. By initially attending, and now facilitating, PTRA workshops, Jakeb emphasizes how his success as a teacher is rooted in the professional development opportunities and camaraderie that PTRA has provided him.

PTRA: 40 Years of Teachers Teaching Teachers

Alice Flarend, *Bellwood-Antis High School*
Nina Morley Daye, *Orange High School (NC), retired*

"Students learn a great deal by explaining their ideas to others and by participating in activities in which they can learn from their peers."

— Brown, Collins, & Duguid, *Situated Cognition and the Culture of Learning* (1989)

The above quote is from a well-known and well-respected paper on teaching and learning. It also represents the main guiding principle behind the AAPT Physics Teacher Resource Agent (PTRA) program, which celebrated its 40th year in 2025.

PTRAs are master physics teachers from across the country who provide professional development in STEM, NGSS, physics, and physical science for teachers in grades K-12. The PTRA program was awarded the 2011 APS Excellence in Physics Education Award.

PTRA workshops, led by master teachers, vary in length, content focus, and location. However, they share common goals of supporting quality physics education professional development and developing teacher leaders. Teachers who learn in a PTRA workshop are asked to wear two hats during the workshop: student and teacher.

When the teachers wear their student hats, they engage in the same activities they will use in their classrooms because professional development is most effective when teachers actively learn with the same strategies they want to implement (Darling-Hammond, Hyler, & Gardner, 2017). The student activities are always more than just "fun" hands-on activities. Each activity is crafted using physics education research, general education research, and the vast experience of the PTRA community. In addition, they often involve low-cost materials. Because PTRAs are teachers teaching teachers, they have inherent street cred with their audience, neutralizing potential pushback from people who think that education reform ideas are generated in ivory towers.

Nationwide, a large portion of high school physics teachers are teaching outside their specialty, so the workshop becomes a rich and safe area for those teachers to, perhaps for the first time, really understand some physics content. Even experienced and fully certified teachers find their knowledge expanded as they face novel, constructivist-inspired, and lab-based problems to solve. All of this is done with the guidance and support of the PTRA facilitators. Working through these demanding activities creates a sense of community that continues even after the workshop ends because the teachers have colleagues to help them. Preservice teachers benefit from observing and participating in expertly run classrooms, which helps them connect with teachers who may soon be their colleagues.

While wearing their teacher hat, participants reflect on the activities from a professional educator's point of view. Sharing the same learning experience as their students affords teachers an avenue to analyze what prompted a breakthrough. Teachers work to address problems of practice with others who have worked in similar situations. In many schools, there is only a single physics teacher. The lack of professional colleagues leaves them feeling isolated and stagnated. For instance, most of their colleagues will not understand the frustration of having students consistently forget to convert mass to weight when the force of gravity is involved.

Using this learning experience makes the workshop a natural place to discuss the pedagogical decisions made during the development and implementation of the activities. Beyond the specific workshop content, participants learn to evaluate an array of pedagogical techniques to solve specific classroom problems or needs. Discussions include an opportunity to suggest changes to the workshop activities that would be advantageous in implementation in their particular classrooms. For example, is the activity better done as a demonstration? Or what questioning strategies can be used to uncover more student prior knowledge, naive understandings, and/or deep connections? The teachers work to adapt the PTRA curriculum to their exact context, rather than having a binder of activities collecting dust in a cabinet because they do not precisely fit the teacher's situation.

In order to be able to do this high-quality professional development, PTRAs stay current in their knowledge of the latest materials from various sources, including new technology from Vernier and PASCO Scientific, presenters at AAPT or NSTA meetings, and a variety of research-based publications. The PTRA members often note emerging trends in curriculum development, such as including more information about quantum and modern physics. Members expand their physics and pedagogical knowledge by participating in annual PTRA bootcamps, AAPT and regional conferences, and university coursework.

No matter the certification, being put in the role of learner is to be put in touch with the feeling of knowing you are wrong about something, and then come through the work with a stronger understanding. This is much more powerful professional development than a slide presentation, where teachers mostly just smile and nod when asked if they agree with a point. Actively learning and building their knowledge in physics education helps establish teachers as experts. We encourage you to collaborate with members of the PTRA program to ignite the potential of the in-service and preservice teachers in your network. For more information about the PTRA program, please contact Justine Harren at jharren@aapt.org.

Alice Flarend whose initial degrees are in nuclear engineering, earned a PhD in Curriculum & Instruction from Penn State. She has been a high school physics teacher for over 30 years and a PTRA for over 15 years. Alice achieved National Board Certification in 2009 and won AAPT's Paul W. Zitzewitz Award for Excellence in K-12 Teaching

Nina Morley Daye has a BST in biology with secondary education and mathematics minors from Appalachian State. Her master's degree is in secondary education with a concentration in physics from NC State. Nina is the 1997 Presidential Awardee for Secondary Science for North Carolina. She earned National Board Certification (AYA in physics) in 2006 and in 2016. She has taught for over 38.5 years in North Carolina.

Empowered by PTRA: A Journey in Physics Education Leadership

Jakeb Rising, *Conemaugh Township High School*

Physics Teacher Resource Agents (PTRA) is a professional development community that has influenced me to become a much better physics teacher and inspired me to become a professional development leader. It has connected me to engaging practices and a phenomenal network of educators, and has immersed me into a strong culture of continual learning.

In my undergrad studies at the University of Pittsburgh at Johnstown, I majored in applied math and secondary math education. Eventually, I went on to add a minor in physics. Physics fascinated me - I felt like understanding physics made me more in tune with the universe, and I was naive to think that I could make sense of the world so long as I had a formula. Admittedly, I had a great deal of growing to do with how I thought about physics. Looking back, my understanding of physics was actually pretty lacking during that time, masked by high competency in math. At first, I was simply "getting away with" learning only the math of physics, doing well on tests, and explaining my lab work by making sense of graphs and formulas.

I feel like this scenario isn't uncommon: being a teacher with an add-on certification in physics but without a full education specifically related to teaching physics. The number of teachers completing physics education programs each year dwindles. According to PhysTEC's National Report Card on Physics Teacher Preparation, Pennsylvania produces only enough qualified physics teachers each year to meet 31.4% of the state's need. That sounds really bad, but I was surprised to learn that Pennsylvania is actually doing really well in comparison to the rest of the United States, ranking 5th overall in terms of meeting the need for producing physics teachers (source: https://phystec.org/report-card/). In smaller schools, it seems common for a teacher certified in math, chemistry, biology, etc., to be asked to teach physics along with those subjects and to do the best they can with it. Multi-disciplinary teachers are jacks-of-all-trades and incredibly talented, but may not have had the opportunity to learn best practices and strategies specific to all of their course offerings.

Without taking any physics education courses, I was missing some fundamental components of good science pedagogy. However, one Saturday in my junior year, I attended a workshop that my advisor had recommended, hosted by PTRA. This would change the direction of my fascination with physics. PTRA Workshops were offered just about every fall and spring, and I started attending in my junior year of college. Led by Dr. Alice Flarend, these workshops helped me to move beyond a math interpretation of physics: the workshops set the example for me of what good physics education looks like, with concept building, science and engineering practices, student discourse, and thought provoking phenomena. From Dr. Flarend's workshops, I was able to take back many successful activities to my classroom.

The workshops PTRA offered covered a wide range of topics, bolstering my lessons with good pedagogy for my introductory physics course, and opening me to teaching content beyond mechanics. I recall strategies I got from Dr. Flarend's workshops years ago and still use today, including card sorts, simulations, lab activities, practicum assessments, and teaching tools. We had used card sorts for teaching sense-making with motion graphs in kinematics, and for problem solving strategies with problems on an inclined plane. We've made "scribble bots", which are a super fun avenue for exploring kinematics concepts. We've done interdisciplinary challenges - one example being a chemistry-physics connection using concentrations of rubbing alcohol and saltwater to get different densities of plastic beads to go exactly to the center of a water bottle. Dr. Flarend's workshops empowered me to teach physics concepts that I did not feel comfortable or knowledgeable enough to teach previously, such as nuclear physics. PTRA workshops introduced me to a multitude of other physics education resources, including those offered from Perimeter Institute and PhET simulations.

Enjoying the positive experiences and energetic collaborations from these local workshops, I sought out opportunities to participate in national PTRA workshops. In the summer of 2023 at James Martin HS in Arlington, TX, I learned how to build a cost-effective PVC pipe rocket launcher for teaching projectile motion, and tons about astronomy in anticipation of the upcoming solar eclipse. In 2024 at Worcester Polytechnic Institute, I learned about Ranking Tasks, Tracker video analysis, CASTLE Circuits, made standing-wave generators, and explored accessible physics lessons from Jan Mader's Teaching Physics for the First Time.

Participating in PTRA over the past several years has naturally led me to start giving back and co-facilitating workshops. I have presented with Dr. Flarend, introducing participants to the new 2025 Pennsylvania standards (STEELS) and phenomena-based instruction. I assisted in preparing and presenting a workshop titled Physics at the Gym, connecting physics to physical education, health, and anatomy/physiology. Most recently, I participated in the PTRA Bootcamp at the AAPT Summer 2025 meeting in Washington D.C. There I learned how to effectively lead my own professional development workshops and make connections with universities and teacher prep programs. This fall I plan to lead workshops on teaching waves content in connection with PA STEELS.

I attribute so many of the successes I have had in my classroom, the "aha" moments for deeply understanding physics content, and the engaging, fun-filled activities I have used to what I have learned from PTRA. This organization has connected me to the most driven physics educators, and I love learning something new from every physics teacher I meet. PTRA has opened a whole new world of physics education to me, and it has connected me with other professional development opportunities like the AAPT National Meeting and Quantum For All. Anyone who teaches physics, whether they just started yesterday or have been teaching for 30 years, would benefit greatly from the innovation and camaraderie that PTRA has to offer. Find workshops near you and make connections with fellow local teachers of physics.

Jakeb Rising is a physics teacher at Conemaugh Township High School in Davidsville, PA. In 2023, he completed his masters in Physics from Texas A&M Commerce. He serves as a PTRA in western and central Pennsylvania, and will soon start serving as a Co-Chair for AAPT's K-12 Education Community.

The Wonders of Physics: Inspiring the next generation of scientists

Haddie McLean, *University of Wisconsin–Madison*

Overview

The Wonders of Physics is a demonstration show with a mission to generate interest in physics among people of all ages and backgrounds. These physics demonstrations are educational and engaging and can be customized for any age group. In 1983, Emeritus Professor Clint Sprott created the program as a public lecture/demonstration show on the UW–Madison campus. The popularity of the Wonders of Physics grew quickly and the show soon became a staple on campus every February. This coming February will be the 43rd annual show. In the late 1980s, graduate students decided to take a smaller version of the annual show on the road and the traveling Wonders of Physics show was born. Last year, the traveling show was performed more than 100 times, with over 8000 students seeing the show.

Annual February Show

The Wonders of Physics annual show is produced by members of the UW–Madison Physics Department. Faculty, both current and emeritus, along with staff, graduate students, and even a few dedicated community members collaborate to write an original show each year. The purpose is to cultivate interest and excitement in physics. Planning starts in September when a theme is selected. Nothing is off limits as past themes include art, chaos and randomness, transportation, and the Olympics. Several small group sketches are written to fit within the theme and demonstrations are created as needed. Demonstrations are chosen based on wow factor and scale, bigger is usually better, but some of the best demonstrations are simple yet counter-intuitive. Each February, eight to ten shows are performed over two weekends. We offer 2500+ free tickets which are usually spoken for within days of release. Over 300,000 people of all ages have seen the Wonders of Physics annual show. It is a wonderful example of informal physics education and key to inviting the general public to join the physics conversation.

Traveling Show

Like the annual show, the traveling show features numerous physics demonstrations from a wide range of physics branches, from motion to modern physics. The show is performed in schools, public libraries, and community centers all around the state of Wisconsin. The department van is loaded with crates of equipment and driven by the presenter to each site. The host group only needs to provide a few long tables and access to electricity. We do not charge for the show, but donations are gladly accepted to help fund the program. Each show is unique; demonstrations are selected based on audience level and explanations are tailored for each group. We connect the physics demonstrations to the audience members' daily life to maximize comprehension. When appropriate, students are shown how to do some of the demonstrations at home. The reactions to the traveling show have been very positive. Students are beyond excited when they experience the demonstrations first-hand. The Wonders of Physics traveling show aims to show students that physics is everywhere and for everyone.

Haddie McLean is The Wonders of Physics Outreach Program Manager at the University of Wisconsin–Madison. She coordinates the annual shows and is the sole presenter of the traveling shows.

Update on APS Education Activities

Michael C. Wittmann, Kayla Baker, Sean Costello, Miranda Gallagher, Adam LaMee, Sam McKagan, Christine O'Donnell, Annelise (Skylen) Roti Roti, *American Physical Society*

I. Thriving Departments support Teaching and Learning

The APS Education team supports two broad areas of physics education: teaching and learning in the classroom, and supporting thriving physics departments. In the teaching and learning team, we support projects like the Physics Teacher Education Coalition (PhysTEC), Faculty Teaching Institute (FTI), and STEP UP. In the thriving departments team, we disseminate materials like the Effective Practices for Physics Programs (EP3) Guide and support communities of change like APS-IDEA. All of these are described below. Additional work we do can be found online at aps.org/initiatives/physics-education - we welcome participation in all our projects! Our goal is to support physics education as broadly defined, helping both the individuals who are learning the physics and the people and systems that support their learning.

We also respond to the needs of the moment, and academia is a changing landscape right now. For example, a proposed rule change by the Trump administration would change the duration of stay rules for temporary visas (F and J) from the length of one's studies to being at most 4 years, with no guarantee of visa renewal. This will have a major impact on Ph.D. programs, where students take on average around 6 years to attain their degrees, and roughly 40% of Ph.D.s are given to temporary visa holders. The rule change could have a drastic impact on graduate education and research in physics! To help the community, we have put together a task force that has published a white paper providing early guidance for physics departments and a webpage for international scholars and students. When the rule change is finalized and made public, we will also be publishing an EP3 Toolkit as part of the EP3 Guide (ep3guide.org), providing more detailed guidance.

In addition to this work, we are restarting our site visit program. Site visits provide departments with a chance to get external input on a particular issue of concern, advice from a site visit team, and help in creating an action plan to improve the department. Site visits can be about enrollment, with a focus on retention as much as recruitment, or departmental culture and the social climate for students and faculty, or many other topics. As with so much of our work, the goal is to help departments thrive, so that students, faculty, and staff can all succeed.

Below, we provide some short descriptions of some of our efforts, as well as some updates on recent work and plans for the near future. These can serve as invitations for participation - if you'd like to learn more about what we're doing, please get in touch at wittmann@aps.org. I look forward to hearing from you!

II. APS-IDEA

APS-IDEA is a network-based initiative working to transform the culture of physics to be more accessible, welcoming, and collaborative in order to support student, faculty, and staff success, belonging, engagement, and well-being. APS-IDEA supports teams from physics departments, laboratories, and organizations as they commit to working on departmental and organizational change, effective recruitment & retention strategies, and climate and culture improvements.

This academic year, APS-IDEA has hosted engaging workshops, peer learning opportunities, and community discussions. One highlight was the launch of our new Collective Learning Series, which brings IDEA teams together in virtual sessions focused on shared learning, practical skill-building, and collective momentum around transforming departmental culture. Looking ahead, APS-IDEA will focus on expanding points of connections and resources to ensure the initiative continues to meet the evolving needs of our community.

III. Effective Practices for Physics Programs (EP3)

The Effective Practices for Physics Programs (EP3) initiative is a collaborative effort between APS and AAPT to promote thriving physics education by empowering departments to create and sustain effective change. EP3 publishes the EP3 Guide (EP3Guide.org), an online living document that curates evidence-based strategies and resources on topics including recruitment, retention, curriculum and pedagogy, and departmental culture and function.

EP3 is currently developing new sections on graduate education that will be published starting next year; three sections are nearing their peer review stages. Additionally, EP3 team members have presented new workshops and webinars to engage the community in using EP3 Guidance. For example, in Spring 2025, we facilitated a virtual interactive workshop on curriculum development, and at the AAPT Summer Meeting, we presented on two recently published sections about implementing and supporting research-based teaching. We are continuing to broaden engagement with the Guide through webinars on managing research groups to support graduate students' experiences as well as in-person workshops at the AAS 247th Meeting and the 2026 Global Physics Summit.

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IV. The Physics and Astronomy Faculty Teaching Institute

The AAPT, APS, and AAS-sponsored Faculty Teaching Institute (FTI) provides yearly opportunities for physics and astronomy faculty to build a strong pedagogical foundation upon which to build engaging classroom experiences for students. FTI engages faculty in reflection on their work, provides evidence-based classroom tools and techniques, and connects faculty to peers who will support their growth as educators.

In June 2025, FTI hosted the project's signature four-day workshop with nearly 60 attendees. Participants in this intensive pedagogical development activity left with new connections, new tools, and a commitment to reflecting on their classroom experiences. There will be an FTI workshop at the Global Physics Summit in Denver CO in March, 2026, and the summer four-day workshop will be held at the end of June, 2026.

V. STEP UP

STEP UP is a national community of physics teachers, researchers, and professional societies. We design high school physics lessons to empower teachers, create cultural change, and inspire young women to pursue physics in college.

In partnership with the Gordon and Betty Moore Foundation, we are happy to announce an expansion of the STEP-UP program in the greater San Francisco Bay Area. This is in addition to existing supported regions in New York City, Chicago, and Los Angeles. We received applications for our newest San Francisco Regional Leadership Team from high school physics teachers, physics faculty and STEM education faculty. For the fall and spring, we invite you to join us for STEP UP Lesson Workshops with links to register found at https://engage.aps.org/stepup/upcoming-events

VI. PhysTEC

The 355 member institutions of Physics Teacher Education Coalition (PhysTEC) work to address the severe national shortage of physics teachers in the United States, where our most recent report card shows 2167 new physics teachers are needed each year at 40% enrollment. Our mission is to ensure every high school student has access to a well-prepared and continually supportive physics teacher, who is equipped to thrive in classrooms with students from all backgrounds. Nearly half of all US physics departments are PhysTEC members with a wide range of physics teacher preparation programs. PhysTEC is centered at the American Physical Society and the American Association of Physics Teachers, with support from the National Science Foundation (#1707990).

The coalition convened in Washington D.C. for two days in August and online in September with the most frequently cited positive aspect of the meetings being making connections. 2026 is the 25th Anniversary of PhysTEC! Sign up for PhysTalk and you will be the first to hear when our 2026 events are announced! info.aps.org/phystalk

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Upcoming newsletter deadlines:

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Spring/Summer 2026: April 15, 2026